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THE UNIVERSITY OF ALBERTA

THE DEVELOPMENT AND UTILIZATION OF THE CANADA LAND INVENTORY

© WILLIAM W. WARREN

A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE
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THE UNIVERSITY OF ALBERTA

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled The Development and Utilization of the Canada Land Inventory.

Submitted by William W. Warren in partial fulfilment of the requirements for the degree of Master of Arts.

Arleigh H. Laycock
Supervisor

Neil Seifried

Thomas L. Burton

Date Nov 27, 1978

DEDICATION

This thesis is dedicated to the many individuals who have contributed to the development and to the utilization of the Canada Land Inventory.

ABSTRACT

In North America the conservation movement gained momentum in the latter half of the nineteenth century and the early part of the twentieth. In Canada, concern was expressed over the misuse of resources,and desires to expand urban settlement within the most productive soil regions of the country were voiced. As a result of these concerns the Canadian Commission of Conservation was established in 1909.

In 1935 the Prairie Farm Rehabilitation Act was passed to provide assistance to farmers in the development and conservation of prairie agricultural lands. Conservation concerns in Eastern Canada resulted in the passage of the Conservation Authorities Act in Ontario in 1946 and the Maritime Marshlands Rehabilitation Act in Nova Scotia and New Brunswick in 1948. Both the Senate's Special Committee on Land Use in Canada in 1957 and the Resources for Tomorrow Conference in 1961 called for the establishment of renewable resource inventories across the country.

These concerns on the conservation of renewable resources culminated in the passage of the Agricultural Rehabilitation and Development Act by the Government of Canada in 1961 and the birth of the Canada Land Inventory. The focus of the inventory was on the establishment of eight resource classifications in which the inherent characteristics

of the land would be documented. Included were present land use, agriculture, agro-climates, forestry, recreation, ungulates, waterfowl and sport-fish. These classifications were intended to be utilized in regional and resource planning.

The primary objective of this thesis has been to outline the development of the Canada Land Inventory and to document its utilization, especially in Alberta. Where possible personal evaluations have been made by the author and views expressed by others have been indicated.

The organizational framework of A.R.D.A. and the Canada Land Inventory is discussed and Provincial expenditures are indicated. The structures of the classifications are outlined and an attempt is made to establish their reliability.

In one chapter the usage made of individual classifications across Canada is indicated and evaluated. The present land use classification has been used to provide a base upon which the capability classifications can be analyzed. One of the primary uses made of the soil capability classification has been to document the loss of high capability lands from agricultural production. Numerous studies have recommended that classes 1 to 3 capability lands should be reserved for the production of crops. The recreation classification has been used to indicate high capability shorelands, the ungulate classification to indicate wintering ranges, the waterfowl classification to indicate migration stops and sport-fish to indicate important fresh water sport-fish resources.

Information from all of the classifications has been incorporated into zoning bylaws, regional plans, policy documents and legislation. Some of the more important uses of the capability classifications are illustrated in those studies in which comparison are made between classifications and land use priorities are established. Integrated capability maps have been prepared and land capability analysis studies have been conducted. In most of the studies cited in this chapter sieve mapping techniques have been employed to determine preferred capabilities and recommended land uses.

The Canadian Geographic Information System which was developed, under the Canada Land Inventory program, for the computerization of the classification data is assessed. Other computer systems developed to handle the C.L.I. information are also discussed.

The most important chapter in the thesis is entitled "The Alberta Experience". The Peers-Whitecourt Land Use Study, the Municipal Affairs Land Use Planning Data Bank, the Lesser Slave Lake Regional Plan, the Provincial Priority Table, the Foothills Resource Allocation Study and the Land Use Assignment Bio-Physical methodology are discussed in detail. Some of the most sophisticated uses made of the C.L.I. classifications are described in this portion of the thesis.

The author concludes that the Canada Land Inventory has had and will continue to have a significant impact upon the patterns of utilization of renewable resources in Canada. Although the classifications have their limitations and constraints it can be said that the program has been a success and its original objectives have been fulfilled.

ACKNOWLEDGEMENTS

I wish to express my appreciation to Dr. A. H. Laycock of the Department of Geography, University of Alberta, for his patience, understanding and constructive criticism during the preparation of this thesis. His knowledge of the subject was extremely beneficial.

I would also like to express my appreciation to those regional planners and systems staff of Alberta Municipal Affairs who made a significant contribution towards the utilization of the Canada Land Inventory.

Special appreciation is extended to Miss Gail Fryer for the typing of the final copy of the thesis.

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CHAPTER I

INTRODUCTION

1. Objectives and Scope

The subject of this thesis is the development and utilization of the Canada Land Inventory, with emphasis placed on its use in Alberta. The Canada Land Inventory has been described as,

> a comprehensive survey of land capability and use specifically designed as a basis for land use and resource planning for agriculture, forestry, recreation and wildlife. Such a program was recommended by the Senate Special Committee on Land Use in 1958 and the Resources for Tomorrow Conference in 1961. Acting on the recommendations of these bodies, the Federal Government approved the Canada Land Inventory program under the Agricultural and Rural Development Act (ARDA) in 1963.[1]

The stress in this study is upon the use of the Canada Land Inventory rather than upon the technical structure of the individual classifications. It will be assumed that the methodological procedures used in developing the classifications were fundamentally sound, and analysis will be restricted to the resultant material which has been prepared.

Approximately thirty million dollars has been expended by the Government of Canada on the collection of present land use and capability information for the Canada Land Inventory. However, it has never been clearly established just how the Canada Land Inventory data could be utilized in regional and resource planning - its intended use.

---

[1] Canada, Department of Regional Economic Expansion, A Guide for Resource Planning, The Canada Land Inventory, Ottawa, 1970.

Canada Land Inventory reports are filled with vague statements regarding the utilization of the classifications. The following quotation is taken from one of the original documents published by the Department of Regional Economic Expansion entitled Objectives, Scope and Organization.

> The Canada Land Inventory was designed primarily for planning rather than for management. It is of a reconnaissance type, it provides information essential to land development planning at the municipal, provincial and federal levels of government. It does not provide the detailed information required for management of individual parcels of land, nor for land planning in small watersheds, local government units, etc. [2]

The uncertainty of use was further exemplified by the C.L.I. Provincial Co-ordinators.

> The recreation information is useful for the preliminary zoning for various recreation uses within large parks and for the designation of lakeshore cottage lots. The forestry maps are to be used for the intended purposes - regional planning. Recreation is compatible with other sectors of the C.L.I. to facilitate inter-sector comparisons in integrated resource management planning. I suggest that it is our job in the inventory to supply basic data for planners and managers which can be interpreted or supplemented or analyzed to suit their purposes. [3]

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[2] Canada, Department of Regional Economic Expansion, The Canada Land Inventory, Objectives, Scope and Organization, Report No. 1, 1965, Second Edition, 1970, pp. 3 and 4.

[3] Anon Correspondence to Department of Regional Economic Expansion from Canada Land Inventory Provincial Co-ordinators, 1969.

It has been generally indicated that the Canada Land Inventory is to be used in regional and resource planning at the regional level of analysis. However, little research has been conducted by the Federal Government as to how the capability classifications are to be or can be utilized. The mandate for regional and resource planning lies primarily with the Provincial Governments; nevertheless, the Federal Government has the ability and obligation to conduct research on this subject.

Having made the assumption that the original inventory data are correct it is relatively simple to deal with one classification sector of the Canada Land Inventory. The recreation capability classification can be adequately utilized in determining those portions of a shoreline which are suited for cottage development. However, what happens when one wants to determine the best use for a specific area of land? One would logically think of comparing the various capability classifications as an initial stage in making this decision.

To date it appears that most of the research into the use of the Canada Land Inventory has been conducted by Provincial agencies and planning consultants who are attempting to use the information in their land use studies. It is unfortunate that they are not provided with more details, for many of these agencies, especially those not involved with renewable resources, are unable to fully comprehend limitations and problems associated with the classifications. As an example the technical staff in some planning offices are using 1:250,000 soil capability for agriculture maps in making subdivision decisions on parcels of land as small as 10 acres.

It is this major problem encompassing the utilization of the Canada Land Inventory which will be concentrated upon in the thesis.

The second chapter will be an historical perspective into the development of land classification systems with the emphasis on the Canadian experience and the important role played by the 1957 Senate's Special Committee on Land Use in Canada and the 1961 Resources for Tomorrow Conference. This historical perspective will be followed by a chapter describing the formation and function of the Agricultural Rehabilitation and Development Act, for it is under this Act that the Canada Land Inventory was created.

The emphasis in chapter IV will be on the structure of the Canada Land Inventory and its present land use and capability classifications. The Inventory consists of five main capability classifications, each based on a seven class rating system.

The Soil Capability Classification for Agriculture contains information on the location, quality and extent of land suitable for the production of annual field crops, forage, improved pasture and native grazing. Associated with the classification are thirteen subclasses or limitations.

The Land Capability Classification for Forestry is a description of the potential capability of land under indigenous tree species for growth and is based upon mean annual increment per acre per year expressed in cubic feet. Associated with the seven classes are eighteen subclasses which are limitations to the use of the land for forestry.

They include such variables as severe climate, undesirable soil structure, adverse topography, excess water, etc.

The Land Capability Classification for Outdoor Recreation is designed to provide reliable estimates of the quality, quantity, type and distribution of outdoor recreation resources. The basis of this classification is the quantity of recreational land use which may be generated and sustained per unit area of land per annum under perfect market conditions. There are twenty-five subclasses which indicate features (positive aspects of the land) such as canoeing, boating, hiking, skiing, etc.

Land Capability Classifications for Wildlife are divided into two categories Ungulates and Waterfowl. The ungulate classification is based upon environmental factors and the boundaries are determined by the physical characteristics of the land. There are eleven subclasses or limitations. The waterfowl classification is based on criteria similar to that for ungulates and there are twelve (limitations) subclasses.

As indicated, the Canada Land Inventory is structured around these five main classifications. However, a Present Land Use Classification was completed for rural land in the settled areas of Canada and in most instances was completed prior to the other classifications. A sixth capability classification, that of Fresh Waters for Sport Fish was developed midway through the Canada Land Inventory program. This classification is based on a four class system rather than the usual seven and is structured on the physical and chemical factors of the environment rather than on landforms. There are seven subclasses or limitations.

An additional classification, The Climates of Canada for Agriculture, was completed to provide climatic data for the Soil Capability for Agriculture Classification. Seven temperature and nine moisture zones were identified and combined to produce a possible sixty-three climatic regions.

The various classifications of the Canada Land Inventory will be investigated as fully as possible in Chapter V in an attempt to determine their accuracy and reliability. How accurate is the seven point system in separating capability potential? The sub-class ratings will also be evaluated to determine their importance to the class rating. A number of research studies have been conducted to assess the accuracy of the various classifications, especially agriculture, and these will be evaluated.

Based upon information within the Land Use Planning Data Bank of the Alberta Department of Municipal Affairs, correlation tests will be performed on the various C.L.I. classifications. Initially it appears that there is a definite correlation between forestry and agriculture capability boundaries and ratings. The relationship between present land use and the capability classifications will also be examined. With regard to the present land use classification, it will also be important to establish its reliability in light of the fact that it is usually obtained from aerial photography taken over a period of up to ten years previous to the classification program.

In addition to investigating relationships between the various Canada Land Inventories several variables from other sources of resource data will be compared to the C.L.I. One such variable will be Final Percentage ratings from Farm Land Assessment Records of the Alberta Department of Municipal Affairs. Final percentage figures indicate the productivity of the soil on an average wheat yield basis compared to ideal black soils which are given an one-hundred percent rating.

These classifications are being compared with each other and to external sources of data to assist in establishing the reliability and usefulness of the Canada Land Inventory.

Having described the structure and established the reliability of the Canada Land Inventory, a review will be made of the uses of individual classifications in Chapter VI. The increasing availability of 1:250,000 maps and information on the C.L.I. has resulted in considerable use of the classifications by government agencies and the private sector.

More important than the use of individual classifications is the utilization of a number of classifications in the development of a system of allocation. This section of the thesis (Chapter VII) will also focus upon those studies in which comparisons of the various capability classifications in a regional context are made. If the Canada Land Inventory is to be used in regional planning, it is logical that the data be manipulated for comparison purposes. It is in this type of analysis that the true value of the Canada Land Inventory can be determined.

From its conception it was recognized that a critical part of the Canada Land Inventory would be the development of a computerized system for the storage and retrieval of the capability data. It would be necessary to make comparisons within and between classifications in map or statistical form. It would also be desirable to create a system which would allow for comparisons with socio-economic inputs. To assist in the utilization of the Canada Land Inventory the Canadian Geographic Information System was developed by the Department of Regional Economic Expansion. This computer system along with a number of others will be discussed in Chapter VIII.

Chapter IX, The Alberta Experience, is considered by the author to be the most important in the thesis. In this chapter the following studies and research projects will be discussed and evaluated: The Peers-Whitecourt Land Use Study, The Land Use Planning Data Bank, The Allocation of Land by Renewable Resource Methodology, The Lesser Slave Lake Regional Plan and the Hinton-Yellowhead Regional Land Use Study prepared by Alberta Municipal Affairs, The Foothills Resource Allocation Study prepared by the Alberta Forest Service and the Biophysical Land Use Studies prepared by the Land Use Assignment Branch of Alberta Energy and Natural Resources. In addition some of the more recent resource studies prepared by Alberta Government departments will be discussed.

In the concluding chapter the author will summarize the major findings of the thesis and provide comments and recommendations on the future use of the Canada Land Inventory. Hopefully with this thesis, users of the C.L.I. may acquire some understanding and appreciation of the various classifications in order to foster their realistic application.

2. Regional Parameters

Before delving into an investigation of the Canada Land Inventory it is necessary to prepare some parameters and define certain terms and concepts which will be referred to repeatedly in this thesis. Was a system such as the Canada Land Inventory needed? What do we mean by land use planning, regional planning, resource planning, land classification, allocation, multiple use and integrated resource management? Why do we hear so much today about land use conflicts? It is important to have explanations to these questions before looking at the utilization of the Canada Land Inventory.

We continually hear about the misuse of our natural resource and the need for land use controls. On October 7, 1975, Environment Canada issued the following news release.

> National Land-Use Policy Called For In Environment Week Statement - It is becoming increasingly clear that wise use of the land is essential to the protection of the natural environment and improvement to the quality of life. Planned land-use is critical in the control of pollution, in the management of renewable resources, and in the production of food.[4]

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[4] Canada, Environment, Lands Directorate, "National Land-Use Policy called for in Environment Week", News Release, Ottawa, 10/7/75.

Morinville area farmers north of Edmonton have indicated their concern over the loss of agricultural land.

> Good agricultural land is being subdivided into 80 acre parcels, sold to city folks and thus taken out of intensive production. The city folks who move out to their acreage are not in a position to really farm their land. Some of them seed it to grass to keep some horses around. Others try to work with antiquated and small machinery. They are just scratching the surface. They are not tilling the land the way it should be done. [5]

In 1973 the Government of Alberta created the Alberta Land Use Forum which was to investigate land uses throughout the Province. Background papers were prepared and hearings were held in early 1975. The Forum in 1976 presented its recommendations to Cabinet, but to date, none of them have been legislated. The British Columbia Land Commission was established in 1973 to protect agricultural lands from urban and industrial development. This commission will be discussed in a subsequent chapter. Concern over the misuse and loss of agricultural lands is expressed at all levels of government from the rural municipality to Environment Canada.

(a) Regional and Resource Planning

In order to assess the utilization of the Canada Land Inventory in regional planning it is important to have an understanding of what is meant by planning and specifically regional planning. Planning is really just a process of thinking ahead. Based on established goals, planning involves the orderly arrangement of particular functions to achieve these goals in a specified period of time. R. S. Thoman in Design for Development in Ontario, defines planning as

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[5] Edmonton Journal, Morinville "Agriculturists Concerned Over Speculators", Edmonton, October 22, 1975, p. 86.

> the establishment of logical objectives and the means for their attainment. Planning is a process involving continuous re-examination of objectives and means in view of current conditions and of changes. [6]

J. W. Maxwell in a paper on Land Use and the Planning Process has defined planning as

> a process that permits us to identify and assess the options available to us when attempting to achieve established goals and objectives.
>
> 1. Goals or objectives must be given or determined.
> 2. Research leading to an understanding of the issues involved must be conducted.
> 3. Alternate strategies for achieving the objectives must be identified and evaluated benefits on the basis of their respective social benefits and costs.
> 4. A particular strategy or plan of action must be selected and implemented.
> 5. The plans implemented must be monitored and modified in response to society's changing demands and values. [7]

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[6] R. S. Thoman, Design for Development in Ontario The Limitations of a Regional Planning Program, Ontario, Department of Treasury and Economics, 1971.

[7] Canada, Department of the Environment, Canadian Wildlife Services, Transactions of the Thirty-fifth Federal-Provincial Wildlife Conference held in Toronto, July 6 - 8, 1971. J. W. Maxwell - "Land Use and the Planning Process" p. 38-39.

Planning is usually divided into two major categories: urban and regional. Urban planning, often referred to as municipal or city planning "may be regarded as a means for systematically anticipating and achieving adjustment in the physical environment of a city consistent with social and economic trends and sound principles of civic design."[8] Regional planning deals with regions which are usually less settled than urban areas and the emphasis is often placed upon the utilization of resources. A significant difference between the two types of planning is the level of detail applied in the case of urban areas. Regional planning deals with urban settlement on a broad perspective. The relationships between urban settlements and the renewable and non-renewable resources on which they depend are studied. For the most part urban planning in North America is centred on the General Plan which provides the necessary framework for dealing with urban land use problems. Regional planning provides a basis for future expansion of an area and the implementation of such programs as transportation systems, resource development, and the location and growth of settlements. For the purposes of this study emphasis will be placed upon the resource aspect of regional planning and specifically renewable resources because the Canada Land Inventory is largely an inventory of renewable resource potential. The analysis of non-renewable resources is certainly an important aspect of regional planning, for the extraction of these resources usually has a profound effect upon the economy of a region. The extraction of non-renewable resources often leads to the destruction of renewable resource potential and hence an evaluation must be placed on both. The Canada Land Inventory is an attempt at an evaluation of the renewable resource component.

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[8] F. S. Chapin Jr., Urban Land Use Planning, University of Illinois Press, Urbana, 1965, p. vi.

The renewable resource component of regional planning provides an evaluation of the resource base in terms of the demands placed upon it for various economic and social needs.

Regional planning has always been a difficult term to define. It is often associated with the preparation of a regional plan, but what is a regional plan? The six Regional Planning Commissions in Alberta are charged with the responsibility of preparing regional plans, but none of the commissions have as yet produced such documents. In fact many planners believe that such plans cannot be prepared because regional planning is a continuing process.

The Alberta Planning Act includes the following criteria for producing a Regional Plan. "A Commission...may study and submit proposals related to (c) the conservation of natural resources, the prevention of pollution of streams, the control of flooding and the utilization of land and resources within the regional planning area." [9]

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[9] Alberta, Government, The Planning Act, Chapter 276 of the Revised Statutes of Alberta, 1970, Part 3. Regional Planning, Regional Plans, Section 68, p. 34.

The Planning Act further states that a regional plan

> (b) shall be prepared on the basis of surveys and studies of land use...the economic base of the regional planning area...and such other factors as are relevant to the preparation of a regional plan. (c) shall include (i) a map showing the division of all or part of the land use classes....(ii) a schedule prescribing the uses of lands....(d) may include (i) proposals to facilitate the development of industrial enterprises especially adapted to the economic base and resources of the regional planning area. [10]

The above legislation provides a mandate for the investigation of renewable resources in the context of preparing regional plans. The guidelines, however, are quite general and details are left to the discretion of the individual Regional Planning Commissions. Guidelines for the preparation of a regional plan in the Alberta 1977 Planning Act are even more vague. "a regional plan (a) shall provide for the present and future land use and development of the planning region, and (b) may regulate and control the use and development of land in the planning region." [11]

In the past the use of resources was controlled at the management level. Foresters managed forests, farmers managed agricultural lands and biologists managed wildlife. Resource planning was in the hands of specialists with specific concerns. Canada was a large country with a small population and few conflicts occurred between resource uses. Since

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[10] Ibid., Section 69, pp. 34-35.

[11] Alberta, Governnment, The Planning Act, Chapter 89, Part 3, Regional Plans and Statutory Plans, 1977, p. 23.

World War II, increased population, not only in Canada but throughout the world has placed significant demands on Canada's resources. Competition for land led to resource conflicts and new terms such as integrated resource management, multiple land use and the optimum use of land began to appear in regional and resource planning literature.

The Canada Land Inventory was created in response to these conflicts and was intended to help resource planners in making land use decisions.

Promotion of regional planning concepts in Canada has often been difficult. People willingly accept urban planning and its associated zoning bylaws and development control regulations, but the same is not true for rural areas. A farmer, in most cases, would resent being told that land within 100 feet of a creek running through his quarter could not be disturbed for agricultural purposes. Concepts of land use controls vary greatly, and yet if regional planning is to be successful government must be able to control more strictly than in the past the use of rural lands. A paper presented by W. D. Ruckelshaus to the Canadian Council of Resource and Environment Ministers in 1972 elaborated on this problem.

> Now it must be admitted that municipalities often lack the resources to manage the development of land-use systems that are regional in scope. Furthermore, local government often critically depends upon development related property tax revenues, so there are powerful economic incentives to develop everything in sight regardless of the consequences. [12]

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[12] W. D. Ruckelshaus - "New Questions on Land Use", Canadian Council of Resource and Environment Ministers, 1972.

The Resources For Tomorrow Conference in 1961 identified the importance of regional planning and the problems associated with its acceptance as a valid area of concern. Many of those identified problems still exist. Regional planning has not been established as an accepted role of government for politicians have been unable to adequately define it. Most planners in the past came from an engineering or architectural background and were involved in city planning. The planning of resources was left to specialists in wildlife, forestry et cetera. However, these resource experts were not trained as planners and did not understand the concerns of regional planning.

> Trying to plan regionally for agricultural or forestry agencies is dangerous. Planning for resources is to be accepted only as an activity which logically leads to overall regional planning, it being thereby made explicit that what may be best for the development of a resource may have to give way to what may be necessary, or preferred, for the good of the nation as a whole.[13]

An attempt will not be made to explain 'for the good of the nation as a whole' as the political aspects of such a statement are well beyond the terms of reference of this thesis.

This identity problem is gradually being resolved as planning schools have a growing output of regional planners. However, many resource specialists continue to feel that they are the planners, and they are at the management level, but not at the regional level. The impression exists that the regional planner is simply a forester, agrologist or zoologist who has specialized in the land use component of resource use. In fact the regional planner is more of a generalist and combines the functions of the others into a regional framework. The regional planner should be able to present an unbiased view relative to the utilization of resources, a view which might be difficult for the resource specialist to present. However, in recent years resource specialists have been trained increasingly to allow for a variety of resources. A forester with training in watershed protection and recreation may be more qualified to plan for renewable resources than a regional planner.

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[13] John Dakin, "Resources For Tomorrow, The Background Papers - Resource Planning & Regional Planning", Planning the Canadian Environment, L. O. Gertler editor, Harvest House Montreal, 1968, p. 135.

If regional planning is to continue, definite aims and goals must be presented. This will be difficult because most regional planning goals will be long range and not as easily definable as are those of resource specialists. A goal of a fisheries biologist may be to increase the sport-fish capacity of a lake by fifty percent. A regional planner may want to zone certain lands for agriculture so that long term agriculture requirements can be met. The biologist's goal can be easily defined and evaluated in a short period of time. The time frame for the regional planner is considerably longer and his goals will be more difficult to justify. The planner's goals are often pre-empted by those with vested interests.

Although the goals of regional planning cannot be well defined, regional planning is gradually obtaining a certain degree of recognition in

Canada. Concern over the use and misuse of renewable and non-renewable resources has become imminent, and politicians have increasingly looked to regional planning for the answers. In fact research in regional planning in the last few years has been centred around the utilization of resources.

The terms of reference of the Alberta Land Use Forum dictated a number of resource concerns the most relevant being points 2, 3, 5 and 8. "(2) multi-use of agricultural land, (3) the use of agricultural land for recreational purposes, (5) future land needs of Alberta Agriculture, (8) land use as it influences population distribution in Alberta." [14]

The evaluation of the Canada Land Inventory relative to its importance in regional planning has arisen out of these concerns for the utilization of natural resources.

(b) Multiple Use

In dealing with natural resources there are several terms that should be clarified. Any discussion of natural resources will certainly have some reference to multiple use. It is a term that has become very popular in recent years. This is especially true for politicians who like to refer to multiple use in justifying to the public their policies on the use of public lands. The Honourable D. J. Russell, Minister of the Alberta Department of the Environment in 1975 issued a policy statement on the development of the Eastern Slopes in which he stated that "the development of the Slopes will be in accord with the wishes and goals of Albertans....The Multiple-Use Policy that the Government is proposing recognizes the emphasis that Albertans have placed on the recreational potential of vast natural areas." [15]

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[14] Alberta, Government, Alberta Land Use Forum, Order in Council No. 1447/73, October 1, 1973 cited in Land Use Forum Report and Recommendations, January, 1976, p. i.

What is really meant by multiple use? The list of definitions and examples is endless. Ontario's Ministry of National Resources in 1966 offered the following definition: "Multiple use of forest and related resources is the deliberate and carefully planned integration of various uses so as to interfere with each other as little as possible and to complement each other as much as possible." [16]

At the Eighth Federal-Provincial Parks Conference held in 1969, multiple use was defined as follows:

> With respect to land, multiple use refers to a scheme of management applicable to fairly large units of land where areas within the unit are used for the purpose for which they are best suited and for such additional purposes as do not conflict with the best or optimum use. Multiple use does not mean that all possible uses of a tract of land should take place simultaneously. Use of individual areas for a single purpose may occur in a multiple use scheme. [17]

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[15] Honourable D. J. Russell, Alberta, Minister of the Environment, Policy Statement: The Development of the Eastern Slopes, July 18, 1975, p. 2.

[16] Ontario, Department of Lands and Forests, "Multiple Use of Forest and Related Lands," 1966, cited in R. J. Madill "Approaches to Multiple Use Planning," The Forestry Chronicle, December 1973, p. 257.

[17] Federal-Provincial Parks Conference, "Eighth Federal-Provincial Parks Conference," Department of Indian Affairs and Northern Development, 1969, cited in J. J. Nowicki, Multiple Use and Management as it Should be in Alberta, Paper presented to National and Provincial Parks Association of Canada, Edmonton Chapter, October 22, 1972. p. 1.

Foresters in Alberta have long considered the Green Area (mostly Crown Lands) as their private domain for the production of wood products. Recreation was an activity which took place in the National Parks or on lakeshores in the settled portions of the province. However, increases in mobility and leisure time and desires of the public to recreate in wilderness areas has placed considerable pressure on the use of forested lands. Multiple use concepts indicate that forested lands should be used for wildlife production, recreation and watershed in addition to their primary use for the production of wood fibre.

Multiple use concepts must be carefully evaluated. An area which has been clear cut for the production of pulp cannot really be considered as a multiple use area. Pulp production is the prime use and other land uses such as wildlife production and recreation must be considered as secondary uses. However, if a time sequence is introduced with the emphasis upon ungulate production after cutting and later upon recreation the term multiple use might be justified. Possibly the term multiple use is more defensible at a macro level as it relates to large areas of forest lands where particular sections are allocated to the harvesting of wood fibre and other blocks of land are left primarily in their natural state for selective cutting, watershed, wildlife and recreation. The latter uses can be considered as compatible with each other but not with the primary use.

Pearse in a paper on "Principles for Allocating Wildland Among Alternative Uses," discusses single and multiple use demands on land. He defines the following categories:

1. demand non-existent - cannot be shown to yield a positive return.
2. single demand - only one form of demand exists.
3. multiple non-competitive demands - production of one product in no way interferes with the production of a second product.
4. multiple conflicting demands - land is demanded for two or more uses which conflict.[18]

The fourth category, multiple conflicting demands, is becoming increasingly prevalent in the allocation of resources. Wilderness groups wish to maintain areas of the Alberta foothills in their natural state with no vehicular access. Ski-doo clubs want trails established in the same areas. Meanwhile, the petroleum companies want to establish exploration roads in their search for oil and gas, and the timber concerns want to clear-cut the lower slopes. The number and variety of demands are multiplying and the Government will be forced to make some difficult decisions.

In reality multiple use is a vague concept, something that is talked about more than it is applied. Detailed studies are required to decide primary and secondary uses and how much one use can be sacrificed for another. A major hinderance in the application of multiple use concepts has been a lack of adequate data. The creation of the capability classifications of the Canada Land Inventory by the Federal Government would hopefully provide some of these data.

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[18] P. H. Pearse, "Principles of Allocating Wildland Among Alternative Uses," Canadian Journal of Agricultural Economics, Vol. 17, No. 1, 1969, pp. 122-124.

The Canada Land Inventory, soil surveys and other land classification systems have provided regional planners with some of the necessary information required for multiple use decisions on land use. However, implementation of multiple use policy is dependent upon management's ability to select land uses for a given area and to legislate them. This final step of legislation is often not reached and the multiple use plan cannot be implemented. Government offices across Canada contain numerous land use plans that have not made that final step to implementation.

> At present multiple use is a phrase to placate the public, a front behind which unco-ordinated resource exploitation goes on apace. Provincial governments are guilty of fraud when their departments apply the term to forests whose only plans are for the industry. [19]

(c) Integrated Resource Management

In 1969 the Sub-Committee on Multiple Use of the National Committee on Forest Land devised a new term to replace multiple use - Integrated Resource Management. It was felt that multiple use had acquired so many different interpretations as to be almost meaningless, and therefore, a new term was required. The Committee defined integrated resource management as follows: "The application of management strategies to achieve the maximum output from the optimized use of natural resources of a specific area for the benefit of a referent-group and its successors."[20]

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[19] S. Rowe, "Environmental Impact of Forest Management Operations - Facts of Ecological Life," Forestry Chronicle, December 1973, p. 300.

In reality integrated resource management is just a sophisticated way of saying multiple use and offers little new to the subject of resource allocation. The word management suggests, perhaps, a finer level of detail in resource analysis, but the overall concept is basically the same as multiple use.

It appears that the above indicated committee was intent upon changing terminology.

> The term 'area planning' has been used in preference to the better-known 'regional planning' for reasons of convenience and practicality. Regional planning appears, under present North American convention to be centred in urban areas, and to include the planning of capital and labour resources... Area planning allows planning to go ahead, based on existing management units, without the necessity for large-scale re-organization along regional planning lines.[21]

The above definition of regional planning may have been true twenty years ago but certainly not since the Resources For Tomorrow Conference of 1961. In fact in recent years research in regional planning has focused on resource utilization both at the government and university level.

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[20] Canada, Department of Regional Economic Expansion, Towards Integrated Resource Management, Report of the Sub-Committee on Multiple Use, National Committee on Forest Land, 1969, p. vii.

[21] *Ibid.*, p. 31.

Regardless of terminology, multiple use planning and integrated resource management, to be effective, must be based on sound land classification systems.

(d) Conflicting Land Uses

Any discussion of multiple use usually includes some reference to conflicting land uses. In fact multiple use concepts often lead to conflict. Many areas of Canada are equally suited to more than one land use and conflicting demands may be placed upon them. Once land is allocated to a particular use the alternate use may be lost. This is especially true in the competition between agricultural and forestry uses.

Once land has been allocated to agricultural production it becomes primarily an exclusive use area. It is relatively easy to convert land from a forestry use to agriculture but the reverse is certainly not true. A forest area could be cleared and producing crops in 3 - 5 years but it would probably take 75 - 100 years for an agricultural area to produce a merchantible crop of wood fibre. Often soils that are limited for the production of cereal crops are equally or better suited to the production of timber. The choice should be governed by economic and social factors and not by political pressure as is often the case. Hopefully the economic criteria would include data on resource capability.

E. L. Ward has pointed out some of the conflicts that have arisen over the allocation of forested land in Ontario.

> The farmer wishes to clear the land so that he can cultivate it to raise crops and domestic animals. The forester wishes to cultivate the trees so that he may harvest the crop of timber. The miner wishes to look for and then extract the minerals. The urban dweller wishes to see the watersheds well clothed with vegetation so that he may have pure water for his own use. The recreationist wishes to fish, hunt, camp, trip, et cetera in the forest or he may just wish to enjoy the scenery and its fresh air.[22]

Conflicts often occur in forested areas where cattle grazing exists. The cattle not only conflict with the growth of young trees but with the ungulate population of the area. Conflicts arise where there is competition between sheep and cattle for forage resources, between production of pulpwood and raw timber, and between wilderness parks and the more popular and intensive recreational uses of the land.

In order to resolve land use conflicts, it is necessary to determine the resource potential of each use for the given area. Land is thus allocated to its most productive use - given certain conditions. In this thesis the author will attempt to show how the Canada Land Inventory can be of value in resolving these conflicts. The prime example will be the work done by the Provincial Planning Branch, Alberta Department of Municipal Affairs on the allocation of land according to its renewable resource potential. The need for such allocative procedures have been indicated by P. H. Pearse. "As demand on rural land becomes more intense, as the best use of land inevitably changes through time, and as the number of alternative uses of land increase and multiplies the problems of conflict in land use, the need for general principles of land allocation, as opposed to ad-hoc decision making, will become increasingly obvious."[23]

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[22] E. L. Ward, "Conflicts in the Use of Forest Lands In Ontario", The Forestry Chronicle, Vol. 38, March 1963, p. 21.

(e) Land Classification and Capability

Prior to documenting the historical development of land classification systems in Canada, which led to the creation of the Canada Land Inventory, the purpose of land classification and capability will be defined. Land classification can be briefly described as the systematic arrangement of criteria into categories. An inventory of land elements such as geology, soils, topography, hydrology, et cetera can be regarded as land classification. Land classification is one attempt to arrange environmental criteria so that they can be used as the basis for land use decisions.

A. Young in a paper entitled "Against Land Classification" presented to the International Geographical Union held in Montreal in 1972 pointed out some of the inherent problems associated with land classification. "Problems arise because of the desirability that planning units should be spatially contiguous and the fact that areas of uniform environment frequently are not."[24] This has definitely been identified as a major problem in the utilization of the Canada Land Inventory for regional planning and will be discussed in considerable detail in a later chapter.

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[23] Pearse, op. cit., p. 122.

[24] A. Young, "Against Land Classification," Proceedings of the International Geographical Union, Montreal, 1972, p. 1185.

One of the major problems associated with land classification is the difference of interpretation by the scientist who generates the data and the regional planner who wants to use it. The scientist is usually a specialist in a narrow field of investigation and may not comprehend the more generalized needs of the planner. The converse is of course true and the planner may generalize the data to a point where it is no longer valid. This problem has been experienced in the utilization of the Canada Land Inventory, and there is disagreement regarding its use between resource specialists and the planners.

Land classification often implies a scale of values and indicates capability levels as in the Canada Land Inventory. Capability refers to the potential of a given land unit to sustain a particular use. Prior to the Canada Land Inventory capability information was sketchy. Forestry surveys and timber cruises were concerned primarily with the inventory of merchantible timber rather than on the capability of the land to produce forests. In order to effectively carry out resource and regional plans it is necessary to measure and map the physical potential, or capability of the land for various uses. This of course is only one component of a larger planning program.

James G. Cruickshank in an article entitled "Why Land Classification?" indicates that "land classification attempts to set out the priorities among competing uses for land, and also, within one particular use, tries to establish either the range of capability or potential productivity."[25]

The preceding section is an attempt to clarify some of the terminology associated with regional and resource planning. The importance of the renewable resource component of regional planning has been emphasized. Multiple use concepts of land use are required for effective planning. However, it is impossible to apply these concepts without a sound datum base. Land allocation requires inventories which rate the potential of the land for various resource uses. One of the primary purposes of the author in this thesis is to evaluate the role of the Canada Land Inventory in filling this requirement.

The importance of resource analysis in regional planning is clearly illustrated in the following quotation. "Any master plan which fails to consider the ecological integrity of the region and fully determines the interrelationships among each element of the land and landscape and each natural resource is scientifically incomplete and legally defective."[26]

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[25] J. G. Cruickshank, "Why Land Classification?" The Brunel Lecture, The British Association for the Advancement of Science, Stirling Annual Meeting, Lecture September 6, 1974, pp. 1-2.

[26] V. J. Yannacone Jr., Future Land Use - Energy, Environmental and Legal Constraints, R. W. Burchell, D. Listokin editors, Centre for Urban Policy Research, Rutgers, - The State University, New Brunswick, New Jersey, 1975, p. 184.

In this introductory chapter the objectives and purpose of the thesis have been outlined. As indicated in the title, the author will attempt to document the development and utilization of the Canada Land Inventory. Terms and concepts,such as regional planning, multiple use, et cetera, have also been discussed as they will appear throughout the thesis.

In Chapter II, Historical Perspective, the evolution of the Conservation movement will be traced, and the development of land and soil classification systems in Canada will be documented.

CHAPTER II

HISTORICAL PERSPECTIVE

1. Origin of the Philosophy of Conservation

Classification systems, such as the Canada Land Inventory, have been discussed and recommended by planners and politicians for decades. The need for natural resource inventories is well documented in the writings of early conservationists. In fact, the origin of this subject can be traced to the conservation movement and will be reviewed chronologically so that the existing situation may be placed in perspective.

(a) Early Developments in Europe and the United States

In the late Middle Ages it was widely believed that the earth and the distribution of natural phenomena was a product of divine effort and design, and that any action brought upon it by man would only aid in improving it. More practical views were held by a few who believed that human activity brought about both desirable and undesirable changes in nature. These observations did not occur in philosophies and natural theologies as much as in learned and technical work which provided the basis for theorization in conservation.

Early writings in conservation dealt with forestry. The forests of Europe were related both to the economics and the amenities of life, and there were conflicts of interests in their use. Land for agriculture and industry was expanding at the expense of the forests. In England in 1664, John Evelyn published *Silva*, a book which described the encroachments of agriculture and the dangers of grazing and of metallurgy.

Agriculture extended itself at the expense of the forests. In addition, the forests were being converted to potash and to charcoal for use in the iron mills.

"Early modern conservation ideas are really a recognition of the fact that the distribution of mineral deposits with relation to forests, even with the industrial development existing before the Industrial Revolution, meant the slow, relentless destruction of nature." [27]

From the late 18th Century to the mid 19th Century the conservation movement increased in scope as Europeans studied the problems of deforestation and soil erosion. The movement grew slowly as resources were considered to be infinite and inexhaustible. In 1776, Adam Smith published his Inquiry Into the Nature and Causes of the Wealth of Nations which promoted national wealth through perfect industrial liberty. Smith popularized the laissez-faire attitude towards the expansion of industry. This attitude was gradually challenged by European Conservationists.

The most influential conservationist in North America in the latter half of the 19th Century was George Perkins Marsh, who in 1864 published Man and Nature or Physical Geography as Modified by Human Action. Attitudes towards resources in America were similar to those in Europe. Resources were regarded as inexhaustible, and some of them were considered as obstructions to the country's development. Over large areas of the United States the forests were regarded as an enemy to be destroyed and burned. However, settlement and agricultural expansion could not have occurred without this destruction. Benjamin Franklin, Benjamin Rush, and a few European visitors to America expressed concern about some of the unsought consequences of agriculture and logging, but the prevailing mood was one of confidence that human effort produced only good. Soils eroded or exhausted were simply vacated for new lands further west, for Americans believed that nature left alone would heal itself.

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[27] John Evelyn, Silva: Or A Discourse of Forest Trees, and the Propogation of Timber in His Majesty's Dominions, New ed. Vol. II, J. Dodsley, 1776, cited in Clarence J. Glacken, "Origins of the Conservation Philosophy." Readings in Resource Management and Conservation, Ed. Ian Burton and R. W. Kates 1965, p. 160.

G. P. Marsh was the first, in the United States, to sense the destruction that was taking place. He observed the changes that men had brought about in the forested hills and valleys of New England. "He conceived of nature as a unity, and his religious and philosophical training, which combined strict Calvinism with German idealism and romanticism, predisposed him to exalt the role of man in nature."[28]

To Marsh, spiritual religion must look elsewhere than the natural world for its evidence. Marsh treated man as an active geological unit; like other agents he could upbuild or destroy.

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[28] D. Lowenthal, "George Perkins Marsh and the American Geographical Tradition", Geographical Review, XCIII, No. 2, 1953, p. 211.

Man and Nature appeared at the peak of American confidence in the inexhaustibility of resources, and it was the first document in America to dispute the myth of super-abundance and to spell out the need for reform. Lowenthal claims,

> Marsh's expose of the damage man has done to the earth is more graphic and comprehensive than any later work on conservation. It is worth reading after a hundred years not only because it taught lessons in its day, but also because it still teaches them so well.[29]

Like his European predecessors, Marsh's main concern was with deforestation. The purposes of preservation and reforestation in the United States were simply to maintain steady supplies of timber and fuel, never to conserve soil and water. Marsh pooled his findings with those of European foresters and offered to the public a philosophy of public responsibility to replace their short-sighted individualism.

In making a study of the lands which had a long history of human settlement, Marsh warned Americans, by comparing environments of old with those of newly settled regions, of the dangers of disturbing the balance of nature.

Although Marsh was living in a time of booming populations, his work does not reflect the concerns of overpopulation raised by Malthus. Malthus was not a conservationist, but in his work An Essay on the

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[29] G. P. Marsh, Man and Nature, Ed., D. Lowenthal, 1965, page IX.

Principles of Population published in 1890 he refers to the problems associated with the misuse of natural resources.

> When acre has been added to acre till all the fertile land is occupied, the yearly increase of food must depend upon the melioration of the land already in possession. This is a fund, which from the nature of all soils, instead of increasing, must be gradually diminishing.[30]

A great deal of early writing regarding conservation in the United States was related to the passage of the frontier. The frontiersmen exhibited strong individualistic traits and resented social controls, and in doing so promoted unregulated use of the natural resources. Generally the rise of the conservation movement is linked to this passage of the frontier, and sporadic action linked to resource abuse was initiated in the late nineteenth century.

Major J. W. Powell, probably the first to make a realistic appraisal of the land resources of the dry and semi-arid West, published his Land of the Arid Regions in 1879. His actions resulted in the establishment of an irrigation division of the United States Geological Survey in 1888.

The initial phase of the conservation movement in the United States was associated with the administration of Theodore Roosevelt in the early nineteen hundreds. Gifford Pinchot, Chief of the United States Forestry Service during this period, is credited with being the main ideological force behind the early conservation movement. The primary emphasis during this period was focused on the problems associated with forestry. Pinchot, however, was opposed to the concept of preservation and the establishment of forest reserves for this purpose. He favoured conservation, and suggested the systematic management of resources.

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[30] T. R. Malthus, An Essay on the Principles of Population, (London: Ward, Lock and Co., 1890), cited in H.J. Barnett, "Malthusianism and Conservation," ed., I Burton and Kates, Readings in Resource Management and Conservation, 1965, p. 208.

Another noted conservationist of this period, and one with views opposing Pinchot was John Muir. His interest was principally nature for nature's sake and he stressed preservation. Muir promoted the esthetic and the ethical philosophy associated with the conservation movement.

The Reclamation Act of 1902, which fostered western development and the concept of multiple-purpose resource development is representative of some of the efforts of the Theodore Roosevelt era.

(b) The Canadian Experience

It was during the same period of growth in the United States that the Conservation Movement in Canada emerged. As in the United States, conservation had been associated with the settlement of the western frontier. In fact, the first conservation effort in Canada probably relates to Palliser's expedition which basically had the same purpose as the Canada Land Inventory which was to follow some hundred years later.

As a result of the spread of settlement in the American interior, which threatened to spill over into Canada, Captain John Palliser in 1857 began his exploration and inventory of lands between the Red River and Rocky Mountains. In the same year, H. Y. Hind set out to report to the Canadian Government on lands as far west as the Saskatchewan River. Both parties participated in what were essentially reconnaissance resource surveys, and there was considerable agreement by them in their interpretation of the agricultural potential of the land. Palliser identified an arid belt partially coincident with the extent of brown and dark brown soils and grasslands. He classified this arid belt as being unfit for agriculture. Hind investigated west of the Missouri Couteau and indicated that the resultant combination of soils and climate produced a sterile region from the point of view of agriculture. The area known as Palliser's Triangle corresponded roughly with the dry short-grass and mixed-grass prairies which cover most of southern Saskatchewan and southern Alberta. Agricultural assessments carried out in this area between 1872 and 1882 by John Macoun for the Canadian Pacific Railway and the Government of Canada disputed Palliser's assessment of the triangle as he insisted upon the fertility of this area. The routing of the Canadian Pacific Railway reflects the reports of Macoun rather than those of Palliser and Hind.

It appears that Palliser was basically correct in indicating that much of this area was unsuitable for farming. However, improved methods of dry land farming and water preservation through irrigation has made much of the region, especially the outer portion of the triangle, agriculturally productive. In retrospect it can be said that Palliser produced the first soil capability analysis in Canada.

R. J. Thorpe in his "Historical Perspective on the Resources for Tomorrow Conference," indicated that "The National Policy of Sir John A. MacDonald's regime, which dominated the generation after Confederation, made an important impact on the development of renewable resources, particularly the agricultural, forest and fish resources." [31]

Canada followed the United States lead and to a limited extent that of J. W. Powell in studying water development and its use in arid regions. Droughts on the Canadian Prairies in the 1880's and 1890's raised doubts about the potential of the west for agriculture and in 1894 the North-West Irrigation Act was established.

In place of riparian rights, legislation was introduced which vested control over the assignment of water rights to the Department of the Interior. The Mormon church was instrumental in developing small irrigation projects in southern Alberta. Many of the early irrigation works were also financed by the railway companies. Direct financial involvement by the Federal Government was not evident until after the droughts in the 1930's.

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[31] R. J. Thorpe, "Historical Perspective on the Resources for Tomorrow Conference," Resources for Tomorrow, Conference Background Papers, Vol. 1, 1961, p. 1.

2. The Conservation Movement in the Twentieth Century

The first major conservation milestone in Canada was the first Canadian Forestry Convention in 1906. The ideas discussed at this conference influenced subsequent activities in the field of resource development in Canada. The main theme of the conference was forest management; however, the relationships between forestry, agriculture and irrigation were discussed. Recommendations of the conference included the desirability of holding forests under Crown ownership and the afforestation of denuded areas to aid in the protection of watersheds. The conference encouraged resource conservation in Canada at a time when the movement was in full swing in the United States.

In 1908, Theodore Roosevelt called the governor of each state to Washington to discuss resource problems. This conference led to the North American Conservation Conference of 1909 which recommended that there should be full scale forest inventories, reforestation, watershed protection and the protection of land better suited for forest growth than other purposes. This latter point by necessity would require capability inventories to establish the best use of the land.

(a) Canadian Commission of Conservation

As a result of the North American Conservation Conference, Laurier and his Cabinet later that same year established the Commission of Conservation which had representation from the federal and provincial governments and the universities. Clifford Sifton, a former minister of the interior, was appointed chairman of the commission. The commission made notable contributions to the conservation of natural resources in Canada, and its annual reports which were published from 1910 to 1919 provided many recommendations related to the need for resource inventories. The committee of lands was oriented towards agriculture, but in addition it considered the problems of land use from a broad ecological viewpoint. Agricultural papers dealt with soil quality, expected yields under cultivation, and inventories of land capable of being cultivated. Consideration was given to the use of land for afforestation which was not suitable for cultivation.

The following statements which relate to the classification of land for resource production are taken from the Fourth Annual Report, Commission of Conservation, Canada, 1913:

> It is essential to the preparation and adoption of any intelligent plan of forest management to... determine the extent and location of the forest resources of Canada. A false sense of security has prevailed in the past, due to the general belief in the existence of a forest resource very much greater in extent than now appears to exist. [32]

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[32] Commission of Conservation, Canada, Report of the Fourth Annual Meeting, Ottawa, 1913, p. 22.

"A brief preliminary reconnaissance of a portion of Northern Ontario was made last summer for the Commission and shows that a large percentage of Ontario west of Sudbury is non-agricultural and is valuable only for the production of timber." [33]

> With reference to the question of taking stock of forest resources, there is an act in New Brunswick providing for that, but it has never been acted upon. I do not know why the Government has not taken some action to arrive at some idea of just what the actual quantity of timber we have in the forest is, and just what the growth is. [34]
>
> Referring to the Prairies - in many cases settlers are taking up lands that are not suitable for agricultural purposes. The lands must be classified into agricultural and non-agricultural.[35]

One of the final recommendations of the 1913 Report was that "the Dominion Government be urged to begin a systematic study of the extent and character of forest resources in the forest reserves and other forest lands under its direct jurisdiction."[36]

These quotations definitely indicate that concepts of resource inventories were developed long before the commencement of the Canada Land Inventory. The need for such inventories was recognized by the Commission and some reconnaissance surveys were actually carried out.

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[33] *Ibid*., p. 23.

[34] *Ibid*., p. 30.

[35] *Ibid*., p. 34.

[36] *Ibid*., p. 179.

The Commission eventually ran into conflict relative to the research studies being conducted and its overlap with Federal Government Departments, and it was dissolved in 1920 approximately one year after the resignation of Sifton, Thorpe in his "Historical Perspective on the Resources for Tomorrow Conference" lists some of the major achievements of the Commission.

> It provided a national forum for the discussion of many topics related to resource development. It stimulated interest in the examination of problems in each resource field and it stimulated an interest in regional planning in Canada. [37]

(b) North American Conservation 1920-1940

There was little activity in the field of conservation between 1920 and 1930 in the United States. During this era no single person dominated the scene or provided the type of leadership evident in the previous period. The natural resource on which most attention was focused during this period was petroleum. The only real interest in conservation was shown by President Hoover who was interested in the orderly development and control of the water resources.

The 1920's was a decade of growth in Canada. Agriculture expanded in the West and the cultivation of wheat expanded northward. The second British Empire Forestry Conference was held in Canada in 1923, and Canada was criticized by other countries for the inadequacy of its conservation activities in the field of inventories. The Conference recommended that Canada should carry out an inventory of its resources.

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[37] Thorpe, op. cit., p. 6.

During the 1930's the conservation movement flourished in North America. The primary emphasis in the United States, under Franklin D. Roosevelt was on land planning and soil improvement. Legislation during this period included the establishment of the Tennessee Valley Authority, the National Resources Board and the Soil Conservation Service.

Discussion of conservation and national development of resources received new impetus in Canada during the thirties. As in the past forest conservation received considerable attention; however, the over-dependence of Saskatchewan and Alberta on wheat resulted in pressure for greater diversification in agriculture. Severe drought in the Prairies indicated a need for irrigation and water conservation. In 1935 the Federal Government established the Prairie Farm Rehabilitation Act, and R. J. Thorpe in "Historical Perspective on the Resource for Tomorrow Conference" indicated some of the reasons for its establishment. "The severely depressed state of agriculture, the need to provide employment, and the insolvency of many municipal governments and of most farmers and corporations involved the federal government and some of the provinces in public resource development projects such as multiple-use, watershed development, irrigation and water supply projects on the Prairies...."[38]

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[38] Thorpe, op. cit., p. 8.

P.F.R.A. provided major changes in approaches to western agriculture. Lands of low productivity, sub-marginal and marginal for crops, were transferred to the Federal Government for development by P.F.R.A. into community pastures. Assistance was provided to farmers for the construction of dug-outs, stock-watering dams and irrigation reservoirs. Under P.F.R.A. extensive soil surveys were conducted, and agricultural diversification with increases in livestock numbers was encouraged.

(c) North American Conservation 1940-1950

Activity in the United States in the 1940's was in the area of international economic recovery. The Paley Report was a major one of a number of postwar attempts in the United States to appraise the status of its natural resources. The conditions of the 1940's made it difficult to generate much public interest in conservation. This period, however, saw the beginning of more participation by private organizations in the area of resource management. The Conservation Foundation evolved in 1948 and Resources for the Future in 1952.

The Canadian Government in 1943 established the Advisory Committee on Reconstruction. This committee called for surveys of forests, soils and wildlife. It recommended multiple use of resources within watersheds, soil surveys to precede all settlement of new land and withdrawal from agricultural use of all sub-marginal lands.

In 1948 the Federal Government passed the Maritime Marshlands Rehabilitation Act, the purpose of which was to rehabilitate 80,000 acres of salt-water marshlands adjacent to the tidal rivers which empty into the Bay of Fundy in Nova Scotia and New Brunswick. The MMRA was intended to increase the agricultural potential of the area. H. Buckley and E. Tihanyi in their book Canadian Policies for Rural Adjustment indicated that the program was overly optimistic.

> The present study finds no evidence that the now completed MMRA program has resulted in extensions to marshland agriculture or in more intensive utilization of the protected lands. The Fundy region appears to remain an area of land abandonment and low income farming where the federal investment of 20 million dollars for the protective structures alone is unlikely to produce agricultural benefits of a comparative magnitude.[39]

In 1950 the Ontario Select Committee on Conservation prepared a report for the Ontario Legislature. The Committee indicated that "to discover and apply the principles of land use, it is first necessary to know the character and distribution of natural resources throughout the Province, and to evaluate them."[40] The importance of soil surveys and the classification of land according to its potential for rotation crops, grasslands and forests were stressed by the Committee.

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[39] H. Buckley & E. Tihanyi, Canadian Policies for Rural Adjustment: A study of the Economic Impacts of the ARDA, PFRA and MMRA Programs, Ottawa, Queen's Printer 1967, p. 15.

[40] Ontario Select Committee on Conservation, Report to the Ontario Legislature, Toronto, 1950, p. 1.

The Conservation Movement in Canada during the first half of the twentieth century resulted in legislation which would direct future renewable resource activity. Equally important during this period was the development of a number of studies which attempted to evaluate the capability of the land for various resource uses.

3. Development of Land and Soil Classifications in Canada

(a) Soil Surveys in Saskatchewan and Alberta

The Saskatchewan Royal Commission of Inquiry into Farming Practices was established in 1920 and soils surveys were begun in 1921. Alberta, also, commenced soil surveys in the early 20's. The soil survey report of the Sounding Creek sheet indicated the need for such studies. "Our best land should be settled first, and since our soil resources are enormous it is unwise to allow farmers to settle on poor land until all the good land is taken up...Many of the settlers have abandoned their farms after vain attempts to produce wheat on land better suited as range land." [41]

Soil surveys in Alberta contained land class maps which were based on physical characteristics such as soil texture, soil colour, mode of deposition, soil profile, degree of stoniness, topography, etc. Each of these factors was given a number value for each soil area, and the multiplying together of these values gave the final index rating of the soil. The soil rating classification developed in Alberta is summarized in Table 1.

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[41] University of Alberta, College of Agriculture, Soil Survey of Sounding Creek Sheet Bulletin Number 16, December 1922, p. vii.

TABLE 1

Alberta Soil Classification

Class 1	poor to fair pasture
Class 2	fair to good pasture
Class 3	good to excellent pasture
Class 4	pasture or marginal arable
Class 5	fair to fairly good arable
Class 6	fairly good to good arable
Class 7	good to very good arable
Class 8	excellent

Source: University of Alberta, College of Agriculture, Soil Survey of Lethbridge and Pincher Creek Sheets Bulletin Number 32, July 1934.

Like the Soil Capability for Agriculture of the Canada Land Inventory this system was divided into classes, the major difference being the reversal of the class structure.

Similarly Saskatchewan developed a system of soil groupings. These groupings were based on suitability for grain production, more particularly for wheat. The numerical rating was obtained by indexing the degree to which the soil profile and topography presented conditions favourable to plant growth. It was also based on the absence of unfavourable conditions such as stoniness, salinity and erodability. The soils were grouped according to the format indicated in Table 2.

TABLE 2

Saskatchewan Soil Classification

I	excellent soils
II	very good soils
III	good soils
IV	moderately good soils
V	fair soils
VI	poor soils
VII	very poor soils

Source: University of Saskatchewan, College of Agriculture, Soil Survey of Southern Saskatchewan from Township 1 to 48, Report No. 12, 1944.

These classes are almost identical to those used later by the Canada Land Inventory in rating soil capability for agriculture. The soil ratings used in Saskatchewan were considered tentative and were to be considered as a general guide to comparative production.

(b) Land Use Classification in the Special Areas of Alberta

In the mid 1930's agricultural surveys were initiated in southwestern Alberta and in 1942 the Federal Department of Agriculture published a report dealing with the classification of land use in the Special Areas. It was hoped that the report would bring a greater measure of stability to the use of the land for agriculture.

A complex classification system unlike any used previously in the Prairies was developed. It is briefly described as follows: "The determination of a preliminary classification involving the estimating of net revenue proceeded through three stages: first, the determination of a gross productivity rating for each quarter-section, based on yields for the soil type of the parcel, and the acreage of tillable land; second, the converting of this measure of gross physical productivity into terms of estimated net revenue, using prices and a budget of costs: and, third, the classification of parcels on the basis of certain ranges of estimated net revenue."[42]

The classification system developed contained four class ratings, 1 - sub-marginal, 2 - marginal, 3 - fair, and 4 - good. These ratings were calculated at a quarter-section level and were partially based on the estimated quantity of wheat that could be produced annually. The classification provided a uniform basis upon which to compare the agricultural potential of quarter sections throughout the region.

The classification recognized the importance of yield, expressed in bushels of wheat/acre/year in the determination of class ratings. The study also recognized the importance of relating these class ratings to the quarter-section unit. However, in this situation it was probably because the quarter section was the original homestead unit, and the economic viability of larger farming units had not as yet been recognized. The Provincial Planning Branch of the Alberta Department of Municipal Affairs, some 30 years later, also recognized the importance of these factors in the classification of rural land. It is interesting to note that the work in the Provincial Planning Branch was done without prior knowledge of the study carried out in the Special Areas.

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[42] Government of Canada, Department of Agriculture, Land Use Classification in the Special Areas of Alberta, Technical Bulletin, No. 39, 1942, p. 29.

(c) The Ganaraska Watershed Study

In 1941 at the Agricultural College in Guelph a conference was held for those interested in the conservation of natural resources for the purpose of formulating a program in resource conservation. Representation was made to the Committee of Reconstruction which agreed to participate in a sample study. It was decided that a watershed study would be carried out in the 268 square kilometre (103 square mile) Ganaraska watershed in southeastern Ontario.

The introduction to the Ganaraska Watershed Study indicates some of the major reasons leading to the creation of such an analysis.

> Deterioration of soil, due in large measure to the removal of forest cover, has given rise to serious problems in many parts of Canada. The soundest and most economical methods must be found by which such land may be brought back into productive use... conservation is apt to be interpreted as either soil restoration or reforestation; but what is really involved is the survey of all resources, leading to multiple-purpose rehabilitation.[43]

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[43] Ontario, Department of Lands and Forests - Interdepartmental Committee on Conservation and Post-War Rehabilitation, The Ganaraska Watershed 1944, p. v.

Although conservation was the main purpose behind the Ganaraska study, it had definite employment objectives. It was hoped that such studies would provide employment in the immediate post-war period and over the longer term to aid in stabilizing the economy. It was indicated that the Ganaraska area could provide work for 600 men for a period of two years.

The Ganaraska report was one of the first comprehensive resource studies to be completed in Eastern Canada, but more important to the purposes of this thesis it classified land according to its use capability. It should not be forgotten that several studies in Alberta and Saskatchewan in which lands were rated according to their capability to produce wheat had already been completed.

Specifically, the soil types in the Ganaraska study were grouped on the basis of their suitability for general farm crops that were grown in the region, and this grouping is shown in the following table:

TABLE 3

Soil Groups - Ganaraska Study

Group I	This group includes a wide variety of soils, which in many instances constitute problem areas. They may be considered as least suitable for general agriculture. They are listed with their main limitations and recommended uses.
Group II	These soils are more suitable for general farming than that in Group I. However, their proper management involves practices which are rather costly in proportion to the returns received. In some instances they can be used to better advantage for some specialized crop.

Group III	These soils are usually quite suitable for general farming but have some limiting features.
Group IV	This group may be considered as the most suitable for general farming. While they also have undesirable features in some instances, they have in general the best inherent capacity to produce good field crops.

Source: Ontario, Department of Lands and Forests, The Ganaraska Report, 1944.

Although these soil groups were designed specifically for the Ganaraska area, on a broader scale they provided the basis for the classification of soils throughout Ontario.

In addition to the soil groupings, land was classified according to its use capability as indicated in Table 4. The five categories that were developed were based on physical characteristics such as soil type, present land use, slope, and degree of erosion:

TABLE 4

Use Capability - Ganaraska Study

I	land suitable for cultivation without special practices
II	land suitable for cultivation with simple practices
III	land suitable for cultivation with complex or intensive practices
IV	land not suitable for continuous cultivation
V	land not suitable for cultivation

Source: Ontario, Department of Lands and Forests, The Ganaraska Report, 1944.

Applicable conclusions of the Ganaraska report indicated that a definite correlation existed between crop yields and soil types. This statement has been challenged throughout the history of land classification and will be discussed in greater detail in a later chapter. The report also indicated that the five land use capability classes were by necessity general in nature. Specific knowledge of actual conditions field by field would be required for detailed planning.

The Ganaraska report was the first of its kind in Ontario, and it appears to have been successful, for Ontario created the Conservation Authorities Act in 1946 to deal with the problems related to watershed conservation.

(d) The Glackmeyer Report in the Clay Belt of Northern Ontario

During the time that the Senate Committee* was meeting, a note-worthy land use study was being conducted in the Clay Belt of Northern Ontario. In fact, Mr. Angus Hills, Chairman of the Committee on Soils and Land Use, Canadian Institute of Forestry, and Chairman for the Report of the Glackmeyer Sub-committee of the Northern Region Land Use Planning Commmittee, spoke to the Senate Committee on the land-use problems encountered in the Cochrane Clay Belt. The Glackmeyer Report of Multiple Land-Use Planning covered approximately 428 square kilometres (165 square miles). The objective of the report was to present practical solutions to the land-use problems that had arisen due to the misuse of the agricultural and forestry resources in Northern Ontario, specifically the Clay Belt.

* The Senate's Special Committee on Land Use is described on pages 57-60.

The report presented a fundamental approach to land-use planning, more comprehensive than any work that had been previously completed. The study demonstrated a methodology of multiple-use planning based on assessment and classification of numerous physical, economic, and social factors and their interrelationships. Based upon land forms and their inherit physical structures, especially drainage relationships, agricultural and forestry use capability classes were established. Agricultural Use-Capability was divided into seven classes as indicated in table 5.

TABLE 5

Agricultural Use-Capability Glackmeyer Report

Class A	lands with very low development costs and low to moderately low maintenance costs, well drained.
Class B	lands with low development costs and low to moderately low maintenance costs, somewhat imperfectly drained.
Class C	lands with moderately low development costs and low to moderate maintenance costs, imperfectly drained.
Class D	lands with moderate costs in both development and maintenance, somewhat poorly drained.
Class E	lands with moderately high costs of development and maintenance, poorly drained.
Class F	lands with high development and maintenance costs, very poorly drained.
Class G	lands with very high costs of development and maintenance, bedrock or open bogs.

Source: Ontario Department of Lands and Forests, The Glackmeyer Report of Multiple Land Use Planning, 1960.

Forest Use Capability was divided into seven classes and defined in terms of yield for both saw timber and pulpwood as illustrated in the following table.

TABLE 6

Forest Use-Capability Glackmeyer Report

Class A	Excellent forest land - over 25,000 FBM saw timber per acre, greater than 50 cords pulpwood per acre.
Class B	very good forest land - 15,000 to 25,000 FBM saw timber per acre, 40 - 50 cords pulpwood per acre.
Class C	good forest land - 7,000 to 15,000 FBM saw timber per acre, 20 - 40 cords pulpwood per acre.
Class D	fair forest land - 1,000 to 7,000 FBM saw timber per acre, 12 - 20 cords pulpwood per acre.
Class E	poor forest land - less than 1,000 FBM saw timber per acre, 5 - 12 cords pulpwood per acre.
Class F	very poor forest land - nil FBM saw timber per acre, less than 5 cords pulpwood per acre.
Class G	extremely poor forest land - nil FBM saw timber per acre, nil cords pulpwood per acre.

Source: Ontario, Department of Lands and Forests, The Glackmeyer Report of Multiple Land Use Planning, 1960.

In order to direct agricultural development to lands having the best potential, a classification was developed based on patterns of agricultural use capabilities within farm units. The units were divided into four choices on the relative proportions of A, B, C and D as outlined below.

TABLE 7

Choice of Farm Units Based on Agricultural Use Capability Classes

First Choice	150 acres or over of classes A and B At least 50 acres class A At least 225 acres of classes A, B, C and D
Second Choice	150 acres or over of classes A and B Less than 50 acres of class A At least 225 acres of A, B, C and D
Third Choice	125 - 150 acres of classes A and B At least 225 acres of A, B, C and D
Fourth Choice	100 - 125 acres of classes A and B At least 225 acres of A, B, C and D

Source: Ontario, Department of Lands and Forests, The Glackmeyer Report of Multiple Land Use Planning, 1960.

These farm lands were further broken down according to a development schedule. The primary agricultural area would be developed between 1960 and 1980 , between 1980 and 2000 the remainder of the first, second and third choices in the primary areas, first, second and third choices in the secondary area and second choices in the tertiary zone, and between 2000 - 2060 the remainder of the fourth choices in the primary zone, fourth choices in the secondary zone and third and fourth choices in the tertiary zone.

The order of development of farm units was based mainly on the agricultural potential of the land, but existing development, rural farm services and farmland consolidation were considered. Forest lands were designated after the limits of expansion of agriculture had been assigned. In order to ensure a balance in resource use, lands were designated for wildlife and recreation land uses. The study, however, indicated that lands for wildlife would primarily be incorporated in the mix of agricultural and forestry designated lands.

The recommended multiple land use plan designated areas by major land uses. Allocation on the map was on a lot basis, 60.7 hectare(150 acre) parcels and not on bio-physical units. Three major agricultural areas, primary, secondary and tertiary were identified. Each of these contained secondary use categories for forestry and wildlife. Forestry was divided into major units, primary and protective. The three remaining areas consisted of wildlife, recreation and urban.

Undoubtedly the methodology evolved in the Glackmeyer Report was significant in the later to be developed capability classifications of the Canada Land Inventory.

Both the Ganaraska and Glackmeyer studies would have a greater influence in the development of the Canada Land Inventory than the agricultural surveys conducted in Western Canada. This was because Ontario resource personnel, especially G. A. Hills, would dominate the initial development of the C.L.I. program. They could influence Ottawa at an earlier stage than researchers from Western Canada.

The Ontario studies covered only small portions of the province and were quite detailed. However, what was required was a broad inventory which would cover all the settled areas of Canada.

4. Senate's Special Committee on Land Use

The next major development dealing with the conservation of natural resources took place in 1957 with the creation of the Senate's Special Committee on Land Use in Canada. The objective of the Committee was to ensure the effective utilization of land resources for the benefit of the Canadian people and their economy.

"In introducing the motion, the leader of the government in the Senate stated that 'It is ... the challenging task of this proposed Senate Committee, (a) to make a broad survey of land use in Canada, (b) to focus public attention on all aspects of this problem, and (c) to invite the best minds in the country to set out their views as to the appropriate solutions, and particularly as these would benefit the farmer and tend to raise farm incomes.'" [44]

Witnesses representing various levels of governments and universities were called before the committee to disclose their expertise in the field of natural resources. It was pointed out that many reliable soil surveys had been conducted across the country, but they were not sufficient for land classification since they dealt only with the suitability of land for agriculture. There was a definite need for a comprehensive system of land classification. It was pointed out that Canada required a system similar to that carried out by the Land Utilization Survey of Great Britain under the direction of Dr. Dudley Stamp. Stamp's land utilization survey was aimed at resolving the conflict between land for agricultural use and land for urban needs. Land for agriculture was classified in three categories, good quality land, medium quality land and poor quality land. H. J. Spence-Sales, Chairman of the Committee on Physical Planning, McGill University had the following comments regarding the classification of land."It seems that in this critical issue of considering the use of land in Canada and what should be done to ensure that our land resources are most effectively utilized ...the very important issue is to consider the balance of competing demands upon the use of land, where possible, to endeavour to secure the reconciliation of rival demands in the best interest of the country." [45]

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[44] Senate of Canada, Report of the Special Committee on Land Use in Canada 1964, pages 9 - 10, cited in T. N. Brewis, Regional Economic Policies in Canada, MacMillan Co., Toronto, 1969, p. 99.

Many of the comments directed to the Committee dealt with the need for classification of the land according to its optimum use. Knowledge concerning the quantity and quality of resources was lacking. Decisions would have to be made as to those areas that should be expanded for agriculture and those areas which should be withdrawn and returned to forestry. It had previously been believed that Canada possessed an endless supply of agricultural land. However, it was pointed out to the Committee that Canada's supply of first-class agricultural land was limited and in some areas was being threatened with urban expansion.

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[45] H. J. Spence-Sales, Proceedings of the Special Committee on Land Use in Canada, The Senate of Canada, Queen's Printer, 1957, pp. 98-99.

With regard to the classification of land according to its optimum use Spence-Sales was probably the most adamant, and it can be said that his recommendations were influential in the eventual establishment of the Canada Land Inventory.

> I would like to suggest that the Federal Government could initiate a classification of land in Canada. It would be an involved undertaking; it would require a great deal of money. I would say that Canada needs its inventory of land, and it needs this inventory in terms of factual aspects of land. I would also suggest that it might be appropriate to establish a land utilization agency or institute. This agency would be required to analyze the inventory and prepare the land classification.[46]

Mr. H. H. Mannam, President of the Canadian Federation of Agriculture recommended to the Senate's Special Committee on Land Use that, "the very excellent soil surveys...should be speeded up and expanded so that complete mapping of all the presently settled areas of Canada is complete as soon as possible."[47]

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[46] Ibid., p. 113.

[47] Ibid., p. 174.

Dr. F. W. Walsh, Deputy Minister of Agriculture for Nova Scotia suggested to the Committee that the Maritime Marshlands Rehabilitation Act should be expanded to cover all lands in the Maritimes. It addition he recommended the establishment of a co-ordination and guiding authority to operate jointly between the Federal Government, the Provinces and the landowners to deal with land use problems.

The Senate Special Committee on Land Use in Canada recommended that a federal-provincial rural development program be initiated, and this recommendation would eventually result in the establishment of the Agricultural Rehabilitation and Development Act.

5. Resources for Tomorrow Conference - 1961

From October 23-28, 1961, the Resources for Tomorrow Conference was held in Montreal and was a major turning point for natural resource policy and planning in Canada. Thomas L. Burton, identified in his book Natural Resource Policy in Canada, a major philosophical change that was taking place.

> The guiding principles of the new conservation movement appear to be social rather than economic. There seems to be a willingness in the movement to accept additional costs, to take decisions which in simple economic terms are unprofitable, in return for a better quality of environment.[48]

The Resources for Tomorrow Conference had its origin in an announcement on February 12, 1958 by the Right Honourable John G. Diefenbaker,

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[48] Thomas L. Burton, Natural Resource Policy in Canada, issues and Perspectives, McClelland and Steward Limited, Toronto, 1972, p. 40.

Prime Minister of Canada, that a national conference on conservation would be called. The conference had three main objectives:

> (1) Identification of the major problems requiring attention in the renewable resource field. (2) Examination of what is being done to solve these problems. (3) Classification of the impediments to further progress and possible courses to achieving solutions to these problems. [49]

On July of 1961, prior to the conference, two volumes containing eighty background papers on natural resources were published. A third volume containing the proceedings was published on February 7, 1962. Several of these papers presented in the first two volumes stressed the need for inventories and the classification of renewable resources.

G. Tunstall, a member of the Eastern Rockies Conservation Board, indicated that a major conflict in renewable resources would be between agriculture and forestry. The problem identified was that most agricultural crops were produced in one growing season whereas the growing period for timber was usually 80 to 100 years. Tunstall, in addition, stressed the importance of inventories. "To avoid the tragedy of settlers struggling vainly for years to grow farm crops on unsuitable land, examination should be made of all wildlands being considered for agricultural development...land use surveys are needed for the new and the already developed areas to ensure better use of the land." [50]

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[49] B. H. Kristjanson, Resources for Tomorrow, Conference Background Papers, Volume 1, 1961, p. foreward.

[50] G. Tunstall, "Using the Forest for Many Purposes". Resources for Tomorrow Conference Background Papers, Volume 2, 1961, p. 662.

W. M. Baker, a recreation consultant and Recreation Co-ordinator for the Resources for Tomorrow Conference expressed the need for a present recreation land use inventory and a recreation land use capability inventory. The quality, extent and location of natural resources upon which various forms of recreation could be supported would be identified in the capability inventory. Baker pointed out that there would be numerous problems in the development of the recreation capability inventory.

> The diversity of the public and private recreation pattern and the variety of possible recreation uses in any particular area, may present some serious problems for the selection of capability classes and the criteria on which they will be based. Agricultural use capability classifications have evolved to their present stage only after a half century or more of voluminous and detailed research in fundamental and applied sciences and a long period of trial and error with various systems. Recreation studies of this type obviously face a similar period of evolution in the years ahead. [51]

The major input of the Resources for Tomorrow Conference dealing with natural resources inventories occurred in the workshop summaries and recommendations later published in Volume 3. The following quotations are taken from the workshop reports in agriculture, forestry wildlife, and recreation.

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[51] W. M. Baker, "Assessing and Allocating Renewable Resources for Recreation," Resources for Tomorrow, Conference Background Papers, Volume 2, 1961, p. 998.

> Agriculture - Demand projections and land-use capabilities provide a basis for planning adjustments in agriculture production to meet expanding and changing consumption needs...it is necessary that each province compile all its existing information and data pertinent to the use of land. These data should be evaluated by the provinces and the evaluations integrated on a national basis with a view to achieving uniform standards...Land unsuitable for cultivation should be shifted to other uses, either agricultural or non-agricultural in order to increase economic productivity and improve social conditions. [52]

> Forestry - In order to establish the basis for decisions on the type and intensity of forest land management, it is agreed that for the country as a whole; (a) criteria of economic productivity be defined taking into consideration such factors as productive capacity and access to markets. (b) a forest land use classification be made in which criteria are taken into account. [53]

> Wildlife - The continuing decrease in the amount and quality of land and water available to wildlife has resulted in urgent problems of supply and utilization of this resource. It is therefore strongly recommended that: (a) all governments of Canada recognize the urgency for now acquiring or designating land and water areas for the primary purposes of wildlife management and maintenance of access for public use and enjoyment. (b) Inasmuch as the waterfowl resource is threatened by the continuing destruction of its natural wetland habitat, there is urgency for the acquisition, designation and management of such waterfowl habitats. [54]

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[52] Agriculture Workshop B - "Adjustments on land in Agriculture, Review and Conclusions", Resources for Tomorrow Conference, Proceedings, Volume 3, 1952, pp. 71-72.

[53] Forestry Workshop B - Discussion, Resources for Tomorrow, Conference Proceedings, Volume 3, 1962, p. 107.

[54] Wildlife Workshops A and B, Joint Meeting, Discussion, Resources for Tomorrow, Conference Proceedings, Volume 3, 1962, p. 126.

> Recreation - In broad terms, the workshop proposed a comprehensive inventory in which, first, supply and demand factors are investigated simultaneously and second, public and private leisure-time activities are enumerated...within the framework the Workshop suggested the following projects (a) Recreation land use inventory, designed to reveal the present extent, location and accessibility of public and private resources for recreation purposes (b) Recreation land use capability inventory designed to reveal the extent, and quality of the resource base throughout Canada for varied recreational development. [55]

The recommendations from these renewable resource workshops clearly indicated the need for capability inventories. This need was further emphasized in the workshops on research. An important requirement was the collection of standardized and comparable base data on resources.

> Accelerated land use, soil and land capability mapping should be undertaken on a national scale to provide needed information on renewable resources. In addition, broad reconnaissance soil and land use mapping should be undertaken in those areas which have received prior surveys. [56]

Dr. J. L. Robinson of the Geography Department, University of British Columbia, provided an extremely relevant observation in his review of the resources papers, "I made a check-list, for my own benefit, of the major research deficiencies which each of the pertinent Background Papers referred to....all six resource sections stressed the lack of basic inventory data - they do not have enough information about their particular resources."[57]

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[55] Recreation Workshop B, Discussion, Resources for Tomorrow, Conference Proceedings, Volume 3, 1962, p. 186.

[56] Research Workshop A, Discussion Resources for Tomorrow, Conference Proceedings, Volume 3, 1962, p. 246.

At the conclusion of the Conference the Research Co-ordinators issued a joint statement. Their first recommendation was: "1. To complete a country-wide assessment of resource supplies which may be set against long-term assessment of resource needs."[58]

The above quotations clearly indicate the emphasis placed on natural resource inventories in the Resources for Tomorrow Conference. This emphasis had previously been indicated in the recommendations of the Special Committee on Land Use in Canada.

The preceding section on historical perspective is a tracing of the development of land classification systems in Canada up until the time of the creation of the Agricultural Rehabilitation and Development Act of 1961. Initially, concern was expressed over the loss of forest lands in Europe. The development of the American and Canadian West initiated the conservation movement which was disturbed over the misuse of soils for agriculture. The Commission of Conservation, established in 1909, was [illegible] major force behind this movement in Canada. Detailed soil surveys were conducted across the Prairies and in 1935 the Prairie Farm Rehabilitation Act was passed to aid farmers in the proper use of their lands. In 1946 the Conservation Authorities Act was passed in Ontario and this led to the detailed study of multiple land use concepts in specific watersheds throughout the province. The Senate's Special Committee on Land Use in Canada, which was established in 1957, recommended the creation of an authority which would classify Canada's lands as to their best use. The Resources for Tomorrow Conference of 1961 re-emphasized this point and called for the classification of land according to its potential for agriculture, forestry, recreation and wildlife.

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[57] Research Workshop B, Discussant, J. L. Robinson, Resources for Tomorrow Conference Proceedings, Volume 3, 1962, p. 253.

[58] Statements by Research Co-ordinators, Joint Statement, Resources for Tomorrow, Conference Proceedings, Volume 3, 1962, p. 479.

From 1909 until 1960 a variety of land classification systems were established in Canada. Most of these dealt with the classification of soils for agriculture and were quite detailed. However, what Canada needed was a more generalized inventory based upon a consistent analysis of land for all the settled areas of Canada. Inventories were required for all renewable resources, not just agriculture, so that the potential for renewable resources could be evaluated for any given area.

The next phase of the thesis deals with the Agricultural Rehabilitation and Development Act and the establishment of the Canada Land Inventory.

CHAPTER III

THE DEVELOPMENT OF THE CANADA LAND INVENTORY

1. Agricultural Rehabilitation and Development Act

As has been previously indicated, ARDA grew out of the recommendations of the Senate's Special Committee on Land Use in Canada which commenced hearings in 1957. It also appears that ARDA grew out of the Resources For Tomorrow Conference which was held in Montreal in October of 1961. This is not entirely true for the Agricultural Rehabilitation and Development Act received assent prior to the Resources for Tomorrow Conference. However, many of the background papers and recommendations of the Resources for Tomorrow Conference provided the necessary insight into the creation of the original ARDA programs. A. T. Davidson, Director of ARDA, in a speech to the Senate Special Committee on Land Use in 1962 indicated that, "the basic thinking central to ARDA lies in the concepts of multiple use and integrated development of resources - ideas also central to the Resources for Tomorrow Conference". [59]

(a) The Creation of ARDA

In December of 1960 the Federal Minister of Agriculture introduced the following resolution: "to authorize the Minister of Agriculture to enter into agreements with provincial governments or agencies thereof for the undertaking jointly with those governments or agencies of projects for the alternative uses of lands that are marginal or of low productivity... and projects for the development and conservation of the soil and water resources of Canada."[60]

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[59] A. T. Davidson, Director of ARDA, A Talk to the Senate Special Committee on Land Use, February, 1962, p. 1.

The Act itself, which was to provide for the rehabilitation of agricultural lands and the development of rural areas in Canada, was given assent on June 22, 1961. The Agricultural Rehabilitation and Development Act (ARDA) stressed several areas of investigation which included projects for the alternative uses of agricultural lands, rural development programs and soil and water conservation projects. As the title of the Act indicates its early emphasis was on agriculture. However, the exact emphasis was not really clear as the terms of references were quite general. J. N. McCrorie in his evaluation of the ARDA program in 1969 indicated that,

> the ARDA legislation was introduced to the Federal Parliament in 1961 with considerable fanfare. Expectations were aroused. Yet the legislation itself was extremely general and vague.[61]

Although an air of vagueness surrounded the Act, great expectations were held for the effectiveness it would have in solving resource problems and inequalities of life in rural areas.

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[60] Canada, Government, Hansard 1960-61 Volume I, p. 819, cited in T. N. Brewis, Regional Economic Policies in Canada, The MacMillan Company of Canada Limited, 1969, p. 104.

[61] J. N. McCrorie, ARDA: An Experiment in Development Planning Special Study No. 2, prepared for the Canadian Council on Rural Development, Queen's Printer, Ottawa, 1969, p. 2.

It was thought that ARDA would be instrumental in carrying out a program of adjustments on land for agriculture and would provide the necessary funds for the expansion of the recreation resource base in Canada.

Administratively, ARDA was established within the Department of Agriculture and early in 1962 agreements were signed with the provinces to carry out various projects. The design of these projects appears to have been influenced by the previous PFRA and MMRA programs and consisted of improvements in land use and the development of soil and water resources.

(b) Purpose of ARDA

Before evaluating the early programs of ARDA, it is important to determine the purposes of the legislation. The Honourable Alvin Hamilton, Minister of Agriculture in May 1961 directed the following statement to Parliament.

> While the program is focused mainly on farm people, it cannot be exclusively agriculture. The program must be one of area development embracing local centres of population as well as the farms surrounding them. The program should be regarded as long-run rather than short-run. It must be recognized at the outset that the problems of marginal areas and of programs developed to relieve these problems will be social as much as economic, political or technological.[62]

ARDA was created to increase rural income through employment opportunities based upon improved management technique in the use of natural resources. Attempts to reduce poverty would also be made through retraining programs so that those affected could seek alternative forms of employment. In summary ARDA had three main objectives:

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[62] Canadian Federation of Agriculture, Agricultural Resources for Tomorrow, Ottawa, 1963 p. 29.

1. To develop alternative uses for land classified as marginal or of low productivity;
2. To develop income and employment opportunities for rural agricultural areas;
3. To develop and conserve the water and soil resources of Canada.[63]

Included in these objectives, is the Canada Land Inventory (C.L.I.). However, the structural organization of ARDA will be described before specific aspects of the C.L.I. are discussed.

(c) Initial Problems

The Agricultural Rehabilitation and Development Act was passed in June 1961, but considerable time passed before programs within the provinces were actually initiated. Initially programs were delayed until the completion of the Resources for Tomorrow Conference in October of 1961. There also appears to have been considerable uncertainty in determining the goals of ARDA, and H. Buckley and E. Tihanyi in their report Canadian Policies for Rural Adjustment indicate reasons why ARDA was so slow in starting.

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[63] *Ibid.*, p. 30.

> In every provincial capital, governments had first to decide what ARDA was for: to raise incomes of farmers generally? To raise income of poor farmers? To conserve natural resources? To improve opportunities in rural areas or to assist rural people to move out? The strong emphasis on research also contributed a delaying effect.[64]

The programs suggested in the ARDA legislation would require extensive planning, new administration and new staff. The ability of provinces to submit programs during the first few years of ARDA appears to have depended on there being programs of a related nature already in existence. Those provinces that were prepared to utilize ARDA showed an interest in the physical resources. A program of stream and river improvements was initiated in Quebec, floodways were built in Manitoba, community pastures were developed in Saskatchewan and Alberta, irrigation projects were developed in British Columbia and blueberry projects were initiated in the Maritimes.

(d) Evaluation of First ARDA Agreement

The first ARDA General Agreement between the Federal Government and the Province terminated on March 31, 1965. Evaluation of the first agreement contained numerous criticisms. J. N. McCrorie in ARDA: An Experiment in Development Planning indicated that

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[64] Buckley H. and Tihanyi E., Canadian Policies for Rural Adjustment, A Study of the Economic Impacts of the ARDA PFRA and MMRA Programs, Ottawa, Queen's Printer, 1967, p. 104.

> the 1961 Federal Legislation...represented attempts on the part of the Federal Government to inaugurate a program of rational resource use and rural development in co-operation with the provinces. The provinces responded in terms of one consideration: money. The nature of the provincial response is reflected in the kind of programming undertaken in the course of the First Federal - Provincial General Agreement. Conspicuosly absent is any significant evidence of long range, comprehensive planning in respect of resource use and rural development. The emphasis, rather, was on ad hoc resource projects; projects that were relatively easy to design, projects that lent themselves to tapping the federal coffers with a minimum of effort and commitment.[65]

There were, however, disadvantages for the provinces, for they were being tied into cost sharing programs reflecting priorities of the Federal Government. The Provinces would also be responsible for the long term maintenance and operation of these programs.

Initial criticisms of the First Agreement were also based upon the strong emphasis placed upon the physical environment while the social aspects of poverty remained initially untouched.

Differences of opinion as to the real purpose of ARDA expressed by both the federal and provincial levels of government tended to delay the creation of programs. The first programs began to appear in 1963 and the agreement ended in March of 1965. They had hardly begun before they ended. The Federal Government's commitment in the first ARDA agreement was $62,438,000 and of this only $24,570,000 was actually spent.

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[65] McCrorie, op. cit., p. 44.

(e) Second ARDA Agreement

The second ARDA agreement was signed by the Federal and Provincial governments in the spring of 1965 and was to remain in effect until March 31, 1970. The Federal government was to contribute up to $125,000,000 over the five year period and would establish a $50,000,000 special fund for rural and economic development (FRED) to provide comprehensive development plans in needy rural areas. The administration of the second ARDA agreement was transferred from the Department of Agriculture to the Department of Forestry and Rural Development. 'Rural' replaced 'rehabilitation' in the new agreement thus reflecting a change in the focus and scope of the program. "Rather than emphasizing improvements in agriculture, the ARDA program now places stress on facing the social and economic needs of the people of the rural areas and on developing various resources to meet these requirements."[66] The emphasis on human development was based on the movement of people and the provision of new employment opportunities in rural areas.

The second ARDA agreement and the Fund for Rural Economic Development flourished between 1965 and 1970 and several major regional economic development plans were prepared. These included plans for Northeastern New Brunswick, Bureau d'amenagement de l'est de Quebec. (BAEQ), Interlake Region of Manitoba and Census Division 14 in Alberta.

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[66] Canada, Department of Forestry and Rural Development, Rural Development Branch, ARDA, 1965-66 Annual Report, p. 1.

The degree to which ARDA was successful in its programs has been discussed numerous times and noteworthy evaluations can be found in the works of J. N. McCrorie, H. Buckley, E. Tihanyi and L. E. Poetschke which are cited in the bibliography.

The preceding account of ARDA has been provided so that the Canada Land Inventory, which was a part of ARDA, can be evaluated in realistic terms. Conflicts as to the direction which ARDA should follow were prevalent throughout the entire length of the programs. Recommendations of the Senate's Special Committee on Land Use and the Resources for Tomorrow Conference stressed the importance of physical resource inventories. As a result, the first ARDA agreement stressed this fact and the Canada Land Inventory was initiated. However, resource inventories were subordinate in the second agreement even though much of the inventory work was done during this period.

(f) Land Capability Component of ARDA

The overall intent of ARDA was to reduce poverty in the economically depressed rural areas of Canada. However, before this could be done it was necessary to assess the capability of the land to see if it was suited for agriculture. Much of the existing poverty was related to the fact that farmers were trying to farm land that was not suited for agricultural production. "It was considered that programs of land adjustment and regional economic development would be both fallible and costly unless there was, first of all, a sound basis for decision on the type of land use that was most desirable, and it was decided that a comprehensive land capability survey would provide the best basis for such decisions."[67]

Competition between land uses advanced the need for an inventory which would evaluate the capability of land. Urban expansion was beginning to threaten agricultural lands, increasing pressures were being placed upon scarce recreational resources, prime forest lands were disappearing and key wildlife ranges were being threatened. In order to plan for these changes it was necessary to have a comprehensive knowledge of the quality and quantity of land resources. This the Canada Land Inventory would hopefully provide.

2. Organizational Structure of the Canada Land Inventory

(a) Objectives and Scope of the Canada Land Inventory

The Agricultural Rehabilitation and Development Act was assented to in June of 1961, and thus legislation permitting development of a wide range of rural programs including the Canada Land Inventory was created. The Senate's Special Committee on Land Use and the Resources for Tomorrow Conference had stressed the need for renewable resource inventories. Competition among various sectors of the economy for land was steadily increasing. Accompanying this was the risk of the misallocation of renewable resources and the depletion of non-renewable resources. There was a need for land to be allocated according to its potential with its limitations clearly indicated.

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[67] T. N. Brewis, Regional Economic Policies in Canada, The Macmillan Co. of Canada Ltd. 1969, p. 106.

"As broad resource management and social planning began to take shape under ARDA and as provincial governments ventured further into the sphere of regional development planning, it became increasingly apparent that without a land capability inventory, programs of land adjustment and regional economic development would be based on judgements which, in the absence of essential information, could be fallible and costly." [68]

If ARDA was to alleviate rural poverty it would have to direct renewable resource activity to those lands that were best suited for the purpose.

The early ARDA programs suggested the movement of people to areas with high capability renewable resources potential. Subsequent programs would direct people in the best use of the land where they lived. The inherent physical characteristics of the land would be documented in the Canada Land Inventory, and the relocation of people would no longer be recommended by ARDA.

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[68] Canada, Department of Forestry & Rural Development, ARDA, Partners in Progress, Queen's Printer Ottawa, 1966, p. 97.

The immense task of preparing land classification systems for an area the size of Canada was pointed out by D. A. Symington. –

> Land capability surveys by governments anywhere in the world are a fairly recent development. Every homesteader or land user of any kind makes his own small personal land capability investigation before settling on a piece of land whose capability seems to suit his purpose. But no real attempt has ever been made in Canada to survey the land capability of the nation as a whole or any major region of it.[69]

The administrative framework for the Canada Land Inventory was established under ARDA in 1962 and funds were made available for conducting the various classifications. However, the provinces were not really in a position to take advantage of this federal funding and commence the undertaking of the C.L.I. classifications. The basic concept of capability classifications had been developed in the federal - provincial - university soil surveys. Extensive soil surveys had been conducted on the Prairies and to a lesser extent in some of the eastern provinces, but the criteria upon which these classifications were based varied considerably and they did not provide data which was considered critical to the individual users of the land.

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[69] D. F. Symington, Land Use in Canada, The Canada Land Inventory, Department of Forestry and Rural Development, Ottawa, pp. 9 and 10, reprinted from the Canadian Geographical Journal, February, 1968.

> There are maps for nearly every agricultural area which describe the quality of the soil - whether it is clay, silt, loam, sand, muck, gravel, rock, peat or various combinations of these - and how the various layers of topsoil and subsoil are arranged. This is extremely valuable information, but it does not tell much about the incidence and amount of rainfall, number of frost free days per season, degree of stoniness, steepness of slopes, ability of the soil to hold enough water for crops and to drain itself of surface water, and all the other factors which mean success or failure to a user.[70]

In addition to the soil surveys carried out across Canada research studies relating capability to productivity had been conducted by provincial and federal government departments in forestry, recreation and wildlife. This expertise was gathered together in Ottawa in November of 1962 to formulate guidelines for conducting the Canada Land Inventory. It was recommended that the C.L.I. include the collection of data on soil capability for agriculture, land capability for forestry, land capability for wildlife and recreation, present land use and socio-economic and climatic classifications. The National Soil Survey Committee met in Winnipeg in March 1963 and recommended that a national capability classification for agriculture be established and that it be conducted by the federal - provincial soil survey organizations across Canada. Later that year the Canada Land Inventory received the approval of the Canadian Council of Resource Ministers who recommended that the inventory be conducted on the basis of working agreements between ARDA and the individual provinces. In October of 1963 the Federal Government officially approved the undertaking of the Canada Land Inventory.

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[70] _Ibid._, p. 10.

An extensive organizational framework was established to co-ordinate the governments and agencies involved in the preparation of the Canada Land Inventory. The C.L.I. was designed as a federal-provincial program under the Agricultural Rehabilitation and Development Act and the governments agreed to participate in the venture as follows:

> The Government of Canada agreed to -
>
> Sponsor and co-ordinate the planning, development and publication of the inventory;
>
> Finance all additional expenditures required of the provinces in the conduct of the inventory;
>
> Foster the development of national classification systems and criteria for their application through co-operative work of federal and provincial agencies;
>
> Provide technical assistance to the provinces in the conduct of the inventory, through the co-operative work of federal research personnel and provincial staffs in related fields;
>
> Provide interprovincial co-ordination of survey methodology and presentation of results;
>
> Provide a system for data processing and map compilation as required in the inventory;
>
> Undertake the publication of results as required, on a national basis, at the scale of 1:250,000.
>
> The Provincial Governments agreed to -
>
> Undertake the planning, development and conduct of the inventory within the province, with the financial and technical assistance of the federal government;
>
> Establish a Provincial Inventory Committee to provide technical and administrative co-ordination for the inventory within the province;

> Develop a provincial plan for inventory work;
>
> Conduct the inventory with technical and financial assistance provided by the federal government;
>
> Undertake publication of results of the inventory which may be of particular interest to the province.
>
> Provide the federal government with all the inventory data required for compilation and publication of results on a national basis. [71]

(b) Priorities and Financing of the Canada Land Inventory

In this section of the thesis provincial and federal expenditures for the Canada Land Inventory from 1963 until 1968 are documented. Priorities established in the provinces for the various land classifications and the overall priority of the C.L.I. as compared to other ARDA programs are investigated. ARDA was designed primarily to help the rural population of Canada to adjust to the economic and technological changes which affected their livelihood. To accomplish this objective, "the act provides for programs involving more effective land use, especially with respect to marginal and sub-marginal agricultural lands; the conservation and improvement of the productivity of lands suitable for agriculture; the development and conservation of rural water supplies; the development of opportunities for improved income and employment in rural areas; and the carrying out of research necessary for implementation of these programs." [72]

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[71] Canada, Department of Regional Economic Expansion, The Canada Land Inventory - Objectives, Scope and Organization, Report No. 1/1965, Second Edition 1970, Ottawa, p. 19.

[72] Canada, Department of Forestry, The ARDA Catalogue, 1962-1965, Ottawa, 1965, p. i.

Although the Agricultural Rehabilitation and Development Act, was proclaimed on June 22, 1961 the first provincial programs did not appear until late 1962 and the first Canada Land Inventory programs until April 1963. The provinces were responsible for the undertaking of the inventories, but the administrative framework required for this task did not exist at the provincial level. The provinces were not ready to spend the thousands of dollars that were being offered to them by the Federal government. In addition, the technical capability to conduct the inventories did not exist. Each individual inventory was to be conducted on the same basis across the country but to ensure this continuity considerable inter-provincial co-ordination would be required. As a result of these factors the C.L.I. was slow in starting.

In the 1963 - 1964 fiscal year emphasis was placed upon the development of a soil capability for agriculture classification with some work in the present land use category. (see table 8). No work was done in any of the other classifications. This emphasis on the soil capability classification can be directly related to the experience gained by the provinces in producing soil surveys. Research into this classification was carried out in all of the provinces with the exception of Newfoundland. The largest expenditures occurred in Ontario, British Columbia and Saskatchewan where 94.62 percent of the 1963-64 C.L.I. budget was committed to the development of this agricultural classification. The remaining 5.38 percent was spent on present land use classifications in Newfoundland and Saskatchewan.

TABLE 8

CANADA LAND INVENTORY EXPENDITURES April 1,1963 to March 31,1964

Province	Present Land Use $	Agriculture $	Forestry	Recreation	Wildlife (ungulates & waterfowl)	Sportfish	Agro-Climatology	Co-ordination and Support	Provincial Total $	%
Nfld.	$ 7,345								$ 7,345	2.39
P.E.I.		$ 15,500							$ 15,500	5.04
Nova Scotia		$ 13,500							$ 13,500	4.39
N.B.		$ 24,975							$ 24,975	8.12
Quebec		$ 12,000							$ 12,000	3.90
Ontario		$ 60,050							$ 60,050	19.53
Manitoba		$ 36,500							$ 36,500	11.87
Sask.	$ 9,200	$ 51,300							$ 60,500	19.68
Alberta		$ 18,500							$ 18,500	6.02
B.C.		$ 58,556							$ 58,556	19.05
Inventory Total	$16,545	$290,881							$307,426	
Percentage	5.38%	94.62%								
								Federal Programs	$158,000	
								Total C.L.I. Expenditure	$465,426	

Source: Canada, Department of Forestry, The ARDA Catalogue 1962-65

This apparent lack of emphasis on the present land use classification is rather misleading. The classification procedures had been developed by the federal government prior to the creation of ARDA and studies had been conducted in the Maritimes, the Lower Mainland and Vancouver Island of British Columbia and Southern Ontario by the Geographical Branch of the Department of Mines and Technical Surveys. Costs were also reduced in the present land use classification as air photographs became the primary information source rather than ground surveys. Of a total ARDA budget of $23,626,951 for 1963-64, $465,426 (1.97%) was spent on the C.L.I.

The C.L.I. began to develop momentum during the 1964-65 fiscal year. (see table 9). Research was forth-coming in the development of a forestry capability classification especially in Quebec, Saskatchewan, Alberta and British Columbia. Saskatchewan led the way in the development of a recreation classification and also contributed along with British Columbia in an initial attempt to develop the wildlife classification. The largest single financial commitment was $159,074 for the agricultural capability classification in Quebec. In fact Quebec received 35.88% of the C.L.I. budget for 1964-65 and was followed by Saskatchewan with 18.62%. As in the previous year the classification receiving the greatest funding was agriculture (35.44%). Forestry which had been non-existent in 1963-64 followed closely behind with 33.87%. The total C.L.I. expenditure was $899,728 or 93% above the previous year. However, this total was only 2.24% of the total ARDA budget for the fiscal year. This figure clearly illustrates that the

TABLE 9

CANADA LAND INVENTORY EXPENDITURES April 1, 1964 - March 31, 1965

Province	Present Land Use $	Agriculture $	Forestry $	Recreation $	Wildlife (ungulates & waterfowl) $	Sportfish	Agro-Climatology	Co-ordination and Support $	Provincial Total $	%
Nfld.		$ 28,400	$ 20,888						$ 49,288	7.08
P.E.I.										
Nova Scotia		$ 17,000							$ 17,000	2.44
N.B.				$ 23,000					$ 23,000	3.30
Quebec		$159,074	$ 90,880						$249,954	35.88
Ontario			$ 14,900						$ 14,900	2.14
Manitoba		$ 21,500							$ 21,500	3.09
Sask.	$ 15,000		$ 31,750	$ 67,750	$ 15,200				$129,700	18.62
Alberta	$ 37,386	$ 20,900	$ 38,500						$ 96,286	13.89
B.C.	$ 12,000		$ 39,000	$ 13,000	$ 13,000			$ 17,500	$ 94,500	13.57
Inventory Total	$ 64,386	$246,874	$235,918	$103,750	$ 28,200			$ 17,500	$696,628	
Percentage	9.24	35.44	33.87	14.89	4.05			2.51		
								Federal Programs	$203,100	
								Total C.L.I. Expenditure	$899,728	

Source: Canada, Department of Forestry
The ARDA Catalogue 1962-65.

C.L.I. was a relatively insignificant part of the entire ARDA project.

Expenditures on the C.L.I. took a massive jump in 1965-66 and increased by 422% over the previous year. (see table 10). Funding was almost equally split between agriculture, forestry, recreation, wildlife and present land use. As in the two previous years the largest amount was spent on the agricultural classification but it was now reduced to 19.65% of the C.L.I. budget. Agro-climatic studies appeared for the first time but were confined to British Columbia. The largest provincial expenditure was British Columbia $879,133 (29.02%). Quebec followed with %589,000 (19.43%). The total C.L.I. budget was $4,693,014 or 12.5% of the entire ARDA budget which represents a considerable percentage increase over previous years.

The 1966-67 expenditures on the C.L.I. showed a slight decrease of 7.4% from the previous year. (see table 11). Manitoba recorded an expenditure of $1,600,000 for the various classifications, and this accounted for 54.16% of all of the Federal funding made available to the provinces. This large expenditure is explained by the fact that only $58,000 had been previously spent on the C.L.I. in Manitoba, and this was entirely on the agricultural classification. During this fiscal year a minimal amount was expended on the sportfish classification. The classification receiving the largest expenditures was

TABLE 10

CANADA LAND INVENTORY EXPENDITURES April 1, 1965 - March 31, 1966

Province	Present Land Use $	Agriculture $	Forestry $	Recreation $	Wildlife (ungulates & waterfowl) $	Sportfish	Agro-Climatology $	Co-ordination and Support $	Provincial Total $	%
Nfld.		$ 25,700	$ 49,800	$ 27,140	$ 31,500			$ 13,800	$147,940	4.88
P.E.I.			$ 7,700	$ 15,000	$ 49,040				$ 71,740	2.37
Nova Scotia		$ 15,000	$ 36,000	$ 20,000	$ 43,000			$ 8,600	$122,600	4.04
N.B.		$ 21,868	$ 21,868	$ 21,868	$ 21,868				$ 87,472	2.86
Quebec		$147,250	$147,250	$147,250	$147,250				$589,000	19.43
Ontario		$103,030	$ 38,250	$ 73,960	$ 34,000			$ 82,000	$331,240	10.93
Manitoba										
Sask.	$185,800	$ 69,400	$ 71,180	$ 35,615	$ 20,840			$ 10,000	$392,835	12.96
Alberta	$143,554	$ 90,640	$ 47,210	$ 45,070	$ 20,400			$ 62,640	$409,514	13.51
B.C.	$156,515	$122,772	$122,772	$ 80,325	$167,225		$139,524	$ 90,000	$879,133	29.02
Inventory Total	$485,869	$595,660	$542,030	$466,228	$535,123		$139,524	$267,040	$3,031,474	
Percentage	16.03	19.65	17.88	15.38	17.65		4.60	8.81		
								Federal Programs	$1,661,540	
								Total C.L.I. Expenditure	$4,693,014	

Source: Canada, Department of Forestry, The ARDA Catalogue 1965-66.

TABLE 11

CANADA LAND INVENTORY EXPENDITURES April 1, 1966 - March 31, 1967

Province	Present Land Use $	Agriculture $	Forestry $	Recreation $	Wildlife (ungulates & waterfowl) $	Sportfish $	Agro-Climatology $	Co-ordination and Support $	Provincial Total $	%
Nfld.					$ 596	$ 596			$ 1,192	.04
P.E.I.			$ 5,000						$ 5,000	.17
Nova Scotia				$ 12,600					$ 12,600	.43
N.B.		$ 25,686	$ 25,686	$ 25,686	$ 25,686	$ 25,686			$102,746	3.48
Quebec										
Ontario			$ 44,016	$ 203,473	$ 44,016			$ 42,000	$333,507	11.29
Manitoba		$375,000	$375,000	$375,000	$375,000			$100,000	$1,600,000	54.16
Sask.		$ 48,460	$ 42,430		$ 35,347	$ 20,418		$ 11,255	$157,910	5.35
Alberta		$ 63,580	$ 36,900	$ 27,800	$ 56,402				$184,682	6.25
B.C.	$ 98,515	$ 68,372	$ 68,372	$ 80,325	$ 80,325		$ 95,710	$ 65,000	$556,621	18.84
Inventory Total	$ 98,515	$581,098	$597,404	$724,884	$617,372	$ 21,014	$ 95,710	$218,255	$2,954,258	100%
Percentage	3.33	19.67	20.22	24.54	20.90	.71	2.34	3.24	100%	
								Federal Programs	$1,392,968	
								Total C.L.I. Expenditure	$4,347,226	

Source: Canada, Department of Forestry and Rural Development, The ARDA Catalogue 1966-67 recreation with $724,884 or 24.54% of the C.L.I. budget. Individual expenditures in agriculture, forestry and wildlife were slightly less than the recreation expenditure. Minimum amounts were spent in all the provinces with the exception of Manitoba. British Columbia accounted for 18.8% of the C.L.I. budget and Ontario 11.3%. The entire ARDA budget increased by 147% over the previous year but the C.L.I. budget was only 4.69% of the overall ARDA budget.

The 1967-68 fiscal year was the last year that the Department of Forestry and Rural Development prepared the ARDA catalogue (see table 12). However, as of March 1968 most of the classifications across Canada were nearing completion and the primary task left to be completed was the publication of maps and the computerization of the data. As generally noted in the previous years the C.L.I. budget was almost equally divided between agriculture, forestry, recreation and wildlife. The largest provincial expenditure was in Ontario with $1,431,501 (34.87%). British Columbia and Quebec followed with 27.01% and 21.47%. Manitoba did not receive any funding for C.L.I. projects during this fiscal year. This probably reflects the large expenditure the previous year. The total C.L.I. budget decreased by 22.81% from the previous year. The C.L.I. budget for 1967-68 was still only a small percentage of the entire ARDA budget (6.48%).

TABLE 12

CANADA LAND INVENTORY EXPENDITURES April 1, 1967 - March 31, 1968

Province	Present Land Use $	Agriculture $	Forestry $	Recreation $	Wildlife (ungulates & waterfowl) $	Sportfish $	Agro-Climatology $	Co-ordination and Support $	Provincial Total $	%
Nfld.		$ 25,000							$ 25,000	.61
P.E.I.										
Nova Scotia		$ 6,956	$ 73,918	$ 42,100	$ 11,900				$134,874	3.29
N.B.		$ 23,000	$ 23,000	$ 23,000	$ 23,000				$ 92,000	2.24
Quebec		$220,362	$220,362	$220,362	$220,362				$881,450	21.47
Ontario		$130,120	$416,916	$559,495	$288,970	$ 36,000			$1,431,501	34.87
Manitoba										
Sask.	$ 77	$141,308			$ 22,867			$ 11,784	$176,036	4.29
Alberta	$ 13,184	$ 47,740	$ 43,485	$ 65,840	$ 59,867	$ 25,087			$255,203	6.22
B.C.	$228,400	$210,738	$210,738	$117,050	$176,322		$ 65,448	$100,000	$1,108,696	27.01
Inventory Total	$241,661	$805,224	$988,419	$1,027,847	$803,288	$61,087	$65,448	$111,784	$4,104,758	
Percentage	5.89	19.62	24.08	25.04	19.57	1.49	1.59	2.72		
								Federal Programs	$534,654	
								Total C.L.I. Expenditure	$4,639,412	

Source: Canada, Department of Forestry and Rural Development, The ARDA Catalogue 1967-68.

During the five prime years that the Canada Land Inventory was conducted a total of $15,044,806 was spent of which $11,094,538 was allocated directly to the Provinces and the remaining $3,950,268 was spent by the Federal Government in C.L.I. research. Table 13 indicates yearly expenditures. The Provinces had been primarily responsible for conducting the various classifications, while the Federal Government tested these, provided the data processing, and produced the mapping. Between 1963 and 1968 approximately $1,180,000 or 30% of the Federal expenditure was spent on data processing. Many problems have arisen regarding the development of a data processing system to handle the C.L.I. information, and this will be discussed in a later chapter which deals with the Canada Geographic Information System.

Canada Land Inventory expenditures for the major classification sectors were well balanced for the 5 year period. (see table 14). Agriculture received 22.71%, forestry 21.31%, recreation 20.94% and wildlife 17.88%. Although wildlife consisted of two classifications, ungulates and waterfowl, it did not involve the complex ratings of agriculture and forestry,and units were generally much larger than in the other classifications. The present land use classification consumed 8.17% of the budget. Some of this classification was conducted by the Federal Government for the provinces prior to the creation of ARDA, and it as well did not involve the complexity of some of the other classification systems. Sport-fish classifications were not conducted until 1966-67 and the creation of these resulted in numerous problems. It appears to have been an "after-thought" and was based on a rating system of 4 rather than on 7 as in the other capability classifications.

TABLE 13

STATISTICAL SUMMARY OF C.L.I. & ARDA BUDGETS

Year	Total C.L.I. Budget	Total ARDA Budget	C.L.I. Budget as % of ARDA Budget
April 1, 1963- March 31, 1964	$ 465,426	$ 23,626,951	1.97
1964 - 1965	$ 899,728	$ 39,999,519	2.24
1965 - 1966	$4,693,014	$ 37,549,938	12.50
1966 - 1967	$4,347,226	$ 92,762,483	4.69
1967 - 1968	$4,639,412	$ 71,606,633	6.48
1963 - 1968 Total	$15,044,806	$265,545,524	5.67

Source: ARDA Catalogues

TABLE 14

CANADA LAND INVENTORY EXPENDITURE BY INDIVIDUAL SECTORS

1963 - 68 for Provinces (does not include Federal Programs)

Sector	63 - 68 Expenditure	% of Total Expenditure
Present Land Use	$ 906,976	8.17
Agriculture	$2,519,737	22.71
Forestry	$2,363,771	21.31
Recreation	$2,322,709	20.94
Wildlife	$1,983,983	17.88
Sport Fish	$ 82,101	.74
Co-ordination and Support	$ 614,579	5.54
Agro-Climatology	$ 300,682	2.71
Total	$11,094,538	100%

Source: ARDA Catalogues

The greatest provincial expenditure was in British Columbia with 24.31% of the C.L.I. budget. Ontario followed with 19.57%, Quebec with 15.69% and Manitoba with 14.94%. It is interesting to note that British Columbia received more funding than either Ontario or Quebec. It is possibly related to the roughness of British Columbia's terrain and its relative inaccessibility. In addition British Columbia placed lesser reliance upon Ottawa in the preparation of the classifications. Alberta and Saskatchewan received almost equal funding, 8.70% and 8.27% respectively. The higher cost in Manitoba is probably partially related to the inflation factor resulting from the province's late involvement in the C.L.I. Table 15 indicates Provincial expenditures.

Although not directly related, it is interesting to note the per capita expenditure (population figures as of 1966 Statistics Canada Census) on the C.L.I. in each of the provinces. (see table 16). The greatest per capita expenditure was in Manitoba at $1.72 followed by British Columbia at $1.44 and Saskatchewan with $0.96. The lowest provincial expenditures were in Quebec and Ontario at $0.30 and $0.31 respectively. The Canadian average was $0.56.

More important and relevant is the area covered by the C.L.I. classifications in each of the provinces and the cost per square kilometre (per square mile) of coverage. (see table 17). This comparison shows some interesting results. The highest C.L.I.

TABLE 15

PROVINCIAL EXPENDITURES 1963 - 68

	Expenditure	Percent	Per Capita (as of 1966 population)
Newfoundland	$ 230,765	2.08	$ 0.46
Prince Edward Island	$ 92,240	.83	$ 0.85
Nova Scotia	$ 300,574	2.71	$ 0.40
New Brunswick	$ 330,193	2.98	$ 0.54
Quebec	$ 1,732,404	15.61	$ 0.30
Ontario	$ 2,171,198	19.57	$ 0.31
Manitoba	$ 1,658,000	14.94	$ 1.72
Saskatchewan	$ 916,981	8.27	$ 0.96
Alberta	$ 964,685	8.70	$ 0.66
British Columbia	$ 2,697,506	24.31	$ 1.44
TOTAL	$11,094,538	100	$ 0.56 Canada average excluding Territories

Source: ARDA Catalogues & Statistics Canada

TABLE 16

PROVINCIAL POPULATIONS 1966

	Population	Percent
Newfoundland	493,396	2.47
Prince Edward Island	108,535	.54
Nova Scotia	756,039	3.79
New Brunswick	616,788	3.09
Quebec	5,780,845	28.95
Ontario	6,960,870	34.85
Manitoba	963,066	4.82
Saskatchewan	955,344	4.78
Alberta	1,463,203	7.33
British Columbia	1,873,674	9.38
TOTAL	19,971,760	

Source: Statistics Canada

costs were in Prince Edward Island at 16.35 per square km. ($41.93 per square mile). Other high cost provinces were Ontario $8.28 ($21.24), Manitoba $7.40 ($18.97) and Quebec $5.91 ($15.16). The lowest costs were in Alberta at $1.97 ($5.05). Costs in New Brunswick and British Columbia were almost identical at $4.62 ($11.86) and $4.61 ($11.83) respectively. A surprizing factor concerning these figures is that Manitoba's costs were $7.40 per square km. ($18.97 per square mile) of coverage while Alberta's and Saskatchewan's costs were $1.97 ($5.05) and $2.42 ($6.20) respectively. One would think that the costs in the Prairie Provinces would be almost identical. The average cost per square kilometre across the country was $4.49 ($11.50 per square mile).

These figures must be used with discretion and cannot be assumed to be completely accurate. The areal coverage in each province is an estimate based on the maps contained in the index to the capability maps produced by the Lands Directorate of Environment Canada. C.L.I. coverage was not consistent throughout the provinces. For example, much of the soil capability for agriculture and land capability for forestry in British Columbia was produced at a scale of 1:125,000 whereas the rest of the country was mapped at a scale of 1:250,000. A large portion of southern Saskatchewan and southeastern Alberta was not mapped for forestry. An ungulate

TABLE 17

PROVINCIAL COSTS PER SQUARE KILOMETRE (SQUARE MILE) OF CANADA LAND INVENTORY COVERAGE

	Area covered by C.L.I. Inventories		Expenditure 1963-68	Cost	
	Sq. Km.	Sq. Mi.	Dollars	Sq. Km.	Sq. Mi.
Newfoundland	111,800	(43,000)	230,765	$ 2.09	($ 5.37)
Prince Edward Island	5,720	(2,200)	92,240	16.35	(41.93)
Nova Scotia	53,040	(20,400)	300,574	5.74	(14.73)
New Brunswick	72,280	(27,800)	330,193	4.62	(11.86)
Quebec	297,180	(114,300)	1,732,404	5.91	(15.16)
Ontario	265,720	(102,200)	2,171,192	8.28	(21.24)
Manitoba	227,240	(87,400)	1,658,000	7.40	(18.97)
Saskatchewan	384,800	(148,800)	916,981	2.42	(6.20)
Alberta	496,860	(191,100)	964,683	1.97	(5.05)
British Columbia	592,800	(228,000)	2,697,506	4.61	(11.83)
Total	2,507,440	(964,400)	11,094,538	4.49	(11.50)

classification was not produced for Prince Edward Island nor was a waterfowl classification done for Newfoundland. These facts will certainly have had some bearing on the cost per square mile for the C.L.I. However, it is believed that the actual costs per square mile for individual provinces would not vary to any great degree from those indicated.

The total C.L.I. budget from April 1, 1963 to March 31, 1968 was $15,044,806. This represents 5.67% of the total ARDA budget of $265,545,524. These figures clearly indicate the low priority that was placed on the Canada Land Inventory by the Federal Government.

Since the completion of the C.L.I. considerable controversy has developed over its usefulness. It would be very interesting to assess the benefits of the other ARDA programs which cost $250,500,718. At $15 million the Canadian government received a bargain in the C.L.I. The cost of conducting such an inventory today would be certainly much higher, and supposedly the capability classifications were so designed that they would not have to be updated.

The expenditure on C.L.I. related programs since 1968 has been considerable. Bureaucracies at both the Provincial and Federal level had been established and needed to be supported. Most of this expenditure has now been incorporated into departmental budgets, and very little is directed to the actual classification of land as was the prime purpose of the C.L.I. between 1963 and 1968.

The foregoing section has been a documentation of some of the costs associated with the C.L.I. The total provincial figures for the fiscal years 1963-64 to 1967-68 are those appearing in the ARDA catalogues and are reasonably correct for actual costs incurred by the Provinces and the Federal government. Not included are administrative costs which were absorbed by various government agencies. However, the classification categories are not as accurate. In most cases the ARDA Catalogue lists the exact expenditure figures for individual classifications. In a few cases a total expenditure figure is given for the province's activities. In these cases the expenditure figures have been equally split between those classifications listed in the ARDA Catalogue. In the 1965-66 ARDA Catalogue the C.L.I. program for Quebec is described as follows: "Collection of physical land data and mapping of soil capability for agriculture and forestry, and land suitability for recreation and wildlife. Total cost $589,000." 73 In this example the expenditure was equally split among the four relevant inventories.

Another limitation is the fact that the ARDA Catalogues which listed expenditures were not published after March 31, 1968. Much of the field work and mapping was finished but few base maps had been submitted to Ottawa. Considerable funding was still required for the

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[73] Canada, Department of Forestry, The ARDA Catalogue April 1, 1965 - March 31, 1966, Ottawa, 1966, p. 24.

data processing systems and the production of coloured 1:250,000 maps for the capability classifications. Some of the Provinces which were late in initiating the classifications still had a considerable amount of field work left, and due to inflation the costs would be high.

Even with the above noted limitations, the section is important for it gives an indication of the financial break-down of the individual classifications in each of the provinces. Thus an economic framework for an evaluation of the individual classifications has been established.

CHAPTER IV

STRUCTURE OF THE CANADA LAND INVENTORY CLASSIFICATIONS

Before investigating the actual utilization of the Canada Land Inventory it is important to have some knowledge of the structure of the individual classifications. What are the criteria upon which they are based and how were they developed? In addition, it is important to have a degree of insight into the procedures utilized in conducting the classifications. The legend for each classification and applicable explanation are located in appendices A to H.

The first classification to be discussed will be that of Present Land Use.

1. Classification for Present Land Use

The classification of land according to its present use would seem a relatively simple matter; however, this is not the case. Before a present land use survey is conducted it must be decided what the purpose of the survey is and at what mapping scale it can best be presented. Land use itself has been defined in many terms. It can include location, natural quality of the land, results of human activity on the land, intensity of use, ownership, et cetera. G. K. Bain and M. H. Sinclair in a paper on land use mapping have offered a definition of land use. "We consider that data legitimate for recording as elements of land use extend not only to those physical phenomena on the surface of the earth which are the results of man's activity, but also to certain natural phenomena such as forests, swamp, marsh and bodies of water." 74

Most people are familiar with large scale land use maps as they relate to urban areas. These maps have become an integral part of the urban general plan and are ideally suited to small land areas. In the last few years an increasingly greater emphasis has been placed on regional planning and thus a requirement for maps of smaller scales covering greater land areas.

Hans Blumenfeld has attempted to define these two types of land use maps.

> At first glance land use appears to be a simple and unequivocal concept....it originated in relation to agriculture. Farm land may be used for growing wheat, or corn, or for grazing cattle... Here the emphasis is on the use of the land, of its productivity capacity. What happens to the land depends on what is taken from it. In an urban environment... the emphasis shifts to use on the land. 75

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[74] G. K. Bain, M. H. Sinclair, Provincial Land Use Mapping, Annual Meeting of the Canadian Association of Geographers, McMaster University, Hamilton, Ontario, 1962.

[75] Hans Blumenfeld, The Conceptual Framework of Land Use, Annual Meeting of the Canadian Association of Geographers, McMaster University, Hamilton, Ontario, 1962.

Urban land use mapping in the United States and increasingly in Canada has tended to be based on the Standard Industrial Classification Code or a variation of this code. Many urban land use systems are also based on a Standard System for Identifying and Coding Land Use Activities as depicted in Marion Clawson's book Land Use Information - a critical survey of U.S. Statistics including possibilities for greater uniformity. In Canada an attempt was made by the Canadian Institute of Planners in the late 1960's to develop a land use classification system that could be used throughout the country. More recently the Alberta Task Force on Urbanization and the Future attempted to develop a land classification for both urban and rural lands. To date neither of the above two Canadian classifications has been adopted.

The present land use classification of the Canada Land Inventory was primarily regional or rural in orientation and required the development of a system dissimilar to those used in urban land use surveys. Emphasis was placed on the development of a present land use survey in Canada in the early 1950's. The International Geographical Union in 1949 appointed a Commission to investigate the feasibility of a world land use survey. As a result a World Land Use System was developed. This system was based in part on a land use classification that L. D. Stamp developed in the Land

Utilization Survey of Britain. The World Land Use System employed nine major categories of land use.

1. (a) Settlements - dark red.
   (b) Non-agricultural land associated with settlements - light red.
2. Horticulture - deep purple.
3. Tree and other perennial crops - light purple.
4. (a) Cropland, used continuously or in rotation - dark brown.
   (b) Cropland, used in a system of land rotation - light brown.
5. Improved permanent pasture - light green.
6. Unimproved grazing land - orange and yellow.
7. Woodland (in six categories) - different shades of green.
8. Swamps and marshes - blue.
9. Unproductive land - grey. [76]

The World Land Use System provided the basis for the present land use classification that was developed by the Geographical Branch of the Federal Department of Mines & Technical Surveys in the 1950's. This present land use survey had begun several years prior to the creation of the C.L.I. under ARDA. During the 1950's and early 1960's the Geographical Branch conducted present land use surveys in the Niagara Peninsula - 1:50,000, southwestern Ontario -

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[76] Harold A. Wood, Small Scale Land Use Mapping - A Critique, Annual Meeting of the Canadian Association of Geographers, McMaster University, Hamilton, Ontario, 1962.

1:50,000, Lower Fraser Valley - 1:50,000, southern Vancouver Island - 1:50,000, Prince Edward Island - 1:126,720, Nova Scotia - 1:250,000, New Brunswick - 1:250,000, Newfoundland - 1:250,000 and on the Prairies 1:500,000. The present land use legends for each of the geographical areas differed only slightly. The classifications were, however, quite different regarding detail and degree of generalization. Prairie mapping units were very large. Maps for Nova Scotia, New Brunswick and Newfoundland combined industrial and commercial areas into one category. Niagara Peninsula maps had separate categories for vineyards, tobacco, tree fruits and small fruits while southwestern Ontario map sheets included sugar beets, soybeans, and orchards. Maps of the Lower Fraser Valley included categories for fur and poultry farms and hops and vineyards. In addition Maritime maps included categories for blueberries and potatoes. The colour codes for all of the regions of Canada were the same and followed the World Land Use System.

During the summers of 1959 and 1960 the Geographical Branch conducted a present land use survey in Prince Edward Island. Field data were compiled on 1:50,000 map sheets and coloured maps were produced at a scale of 1:126,720. The survey in Prince Edward Island pointed out the need for a detailed report to accompany land use maps.

> But such maps alone are insufficient to explain the reasons for, and the interrelationships of, the various land-use categories. For these purposes, explanatory memoirs are needed. In addition, such monographs can incorporate the wealth of material and observations collected during field work that cannot find expression on the map. [77]

During the same period of time that the P.E.I. study was carried out, a detailed land use study was conducted by the Geographical Branch in the Niagara Peninsula. Field mapping and air photo interpretation was conducted by the Geographical Branch and the Ontario Community Planning Branch and eleven 1:50,000 map sheets were published for the area.

The Geographical Branch, the agency most closely associated with the development of a land use mapping program in Canada, was asked to develop the present land use classification for the Canada Land Inventory. Work on the development of the classification which was to cover approximately 2,849,000 sq. km. (1,100,000 sq. mi.) at a scale of 1:50,000 and require 3,000 National Topographic System half-sheets, each covering approximately 583 sq. km. (225 s. mi.) was begun in 1963.

Previous land use studies conducted by the Branch had been produced using a field-by-field survey technique. However, it would be impossible to complete the C.L.I. survey in this manner as the project was to be finished in four years. A trained photo interpreter can complete a 1:50,000 map sheet in three days, but it would take three weeks to do the same map in the field. It was decided that the survey should be conducted through air photo interpretation supplemented by field checks. Due to the time and financial constraints it would be impossible to produce monographs similar to those that were considered important in the preparation of land use maps in Prince Edward Island.

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[77] C. W. Raymond, J. B. McLellan, J. A. Rayburn, Land Utilization In Prince Edward Island, Memoir 9, Geographical Branch, Department of Mines and Technical Surveys, Ottawa, 1963, p. v.

The present land use classification was designed by the Geographical Branch for two main purposes, to estimate the extent and location of land uses in the settled parts of Canada and to provide a basis for a comparison with the capability of the land. It was anticipated that the classification would provide information that could be cross-classified with other data to produce the following information, "location and extent of land now under cultivated crops but with soils that are unfavourable to the production of these crops - location and extent of land now abandoned, idle or extensively used that is capable of producing cultivated crops or perennial forage crops - nature of the present cover on land suitable for reforestation - nature of the present cover on land rated highly for recreational purposes." [78]

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[78] J. B. McClellan, "The Land-Use Sector of the Canada Land Inventory" Geographical Bulletin, Volume 7, No. 2, 1965, p. 74.

In the spring of 1964 the classification system developed by the Geographical Branch was submitted for comments to the university geography departments across Canada and to governmental land use planners. By the end of the year a final version of the classification was completed.

In Alberta the Present Land Use classification was contracted to Dr. A. H. Laycock of the Geography Department of the University of Alberta and work commenced in September 1964. A pilot project was initially conducted in those areas covered by map sheets 83H (Edmonton) and the east half of 83G (Wabamun Lake) and 60,762 sq. km. (23,461 sq. mi.) were mapped. The project involved a significant amount of testing of the classification, and some modification of definitions and procedures for use in the Prairies was recommended. In total approximately 414,400 sq. km. (160,000 sq. mi.) were covered by the classification in the province.

C. L. A. Hutton in a paper on the present land use project in Alberta commented on the classification.

> It is readily apparent that the classification is not restricted to land use; it involves also the character of areas, such as the woodlands, the wetlands, unproductive lands and open water areas where little or no human use may occur. Even some of the areas classed as 'unimproved pasture and rangeland' are not currently utilized, but the category includes all natural grasslands regardless of use. [79]

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[79] C. L. A. Hutton, Mapping Present Land Use in Alberta...an ARDA project, The Albertan Geographer, Department of Geography, University of Alberta, No. 2, 1965-66, p. 34.

The present land use classification was one of the first C.L.I. programs to be completed and provided a land basis for the capability classifications. The classification, however, encountered several problems which resulted in a number of limitations. These problems and limitations will be discussed in the next chapter. A complete description of the present land use categories is provided in Appendix A.

2. Soil Capability Classification for Agriculture

The Soil Capability Classification for Agriculture was one of the first classifications to begin after the creation of ARDA. The classification was developed by the National Soil Survey Committee in co-operation with the federal and provincial ARDA administrations. Like the present land use classification which was based on previous studies, the soil capability classification for agriculture was based on soil surveys which had been completed by the soil survey organizations across the country. In some areas original mapping was required as soil surveys had not been previously prepared. In Alberta the classification was conducted by the Alberta Soil Survey under the direction of E. Bowser, T. W. Peters, W. Odynsky and J. D. Lindsay.

The field maps prepared for the classification were mostly at a scale of 1:63,360 and in some areas at a scale of 1:126,720. Published coloured maps for the inventory area are at a scale of 1:250,000.

The soil classification was developed from the soil mapping units of the soil survey reports. Like the other capability classifications the soil classification is divided into seven categories. "The first three classes are considered capable of sustained production of common cultivated crops, the fourth is marginal for sustained arable culture, the fifth is capable of use only for permanent pasture and hay, the sixth is capable of use only for wild pasture, while the seventh class is for soils and land types (including rock outcrop and small unmappable bodies of water) considered incapable of use for arable culture or permanent pasture." [80]

The soil capability classification for agriculture consists of classes and sub-classes.

> The class, the broadest category in this classification, is a grouping of sub-classes that have the same relative degree of limitation or hazard. The limitation or hazard becomes progressively greater from Class 1 to Class 7. The class indicates the general suitability of the soils for agricultural use. The sub-class is a grouping of soils with similar kinds of limitations and hazards. It provides information on the kind of conservation problem or limitation. [81]

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[80] Canada, Department of Forestry, Soil Capability Classification for Agriculture, The Canada Land Inventory, ARDA Report No. 2, 1965, p. 3.

[81] Ibid., p. 3.

Organic soils are indicated by the letter O. They are not sub-classified as insufficient information for interpretative judgements was available. A complete description of the classes and sub-classes is located in Appendix B.

The classification is applied to all lands within the boundaries of the inventory regardless of whether they are cultivated or not. It is more detailed and accurate in those areas covered by soil survey reports and where it is based on recorded observations. In areas where this information is lacking the capability classes and sub-classes are based on similar soils elsewhere.

It must be realized that considerable generalization was involved in the preparation of this classification, The accuracy of the classification depends on a variety of factors and the assumptions upon which the classification is based must be understood.

Assumptions -

1. The soil capability classification is an interpretive classification based on the effects of combination of climate and soil characteristics, on limitations in use of the soils for agriculture, and their general productive capability for common field crops.
2. Good soil management practices that are feasible and practical under a largely mechanized system of agriculture are assumed.

3. The soils within a capability class are similar with respect to degree but not to kind of limitations in soil use for agricultural purposes. Each class includes many different kinds of soil and many of the soils within any one class require unlike management and treatment.

4. Soils considered feasible for improvement by draining, by irrigating, by removing stones, by altering soil structure, or by protecting from overflow, are classified according to their continuing limitations or hazards in use after the improvements have been made. The term 'feasible' implies that it is within present day economic possibility for the farmer to make such improvements and it does not require a major reclamation project to do so. Where such major projects are installed, the soils are grouped according to the soil and climatic limitations that continue to exist.

5. The capability classification of the soils in an area may be changed when major reclamation works are installed that permanently change the limitations in use for agriculture.

6. Distance to market, kind of roads, location, size of farms, characteristics of land ownership and cultural patterns and the skill or resources of individual operators are not criteria for capability groupings.

7. Capability groupings are subject to change as new information about the behaviour and responses of the soils becomes available.[82]

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[82] Ibid., p. 5.

It is important to note that the classification does not include information on the types of soils involved but indicates only that they are mineral based. The underlying basis of the soil capability classification is that soils on the Prairies were assessed on their capability for growing cereal grains (wheat, oats, barley) while in other parts of the country the basis may have been different (e.g., corn, root crops, etc.).

Considerable controversy has developed over the use of the soil capability classification for agriculture. Much of this has developed due to a lack of understanding of the assumptions noted above.

3. Agro-Climatic Classification

The agro-climatic classification is probably the least known of all the C.L.I. classifications. It was produced in 1966 to provide necessary climatic data for the soil capability for agriculture classification, and was not intended to be published in map form as with the capability classifications. ARDA has recognized the importance of climate to the productivity of land for agriculture, for temperatures and moisture have a direct influence on the yield of crops in any particular year.

The classification was prepared by L. J. Chapman and D. M. Brown of the Department of Physiography, Ontario Research Foundation, with climatic data obtained from the Meteorological Branch of the Department of Transport. Temperature, the growing season, and moisture data for the settled areas of Canada were tabulated and mapped. The information was then combined to form a climatic classification. Seven temperature zones were defined in terms of average number of degree days above 42°F. Nine moisture classes were identified based on average water deficiency and average May to September precipitation.

The temperature zones and moisture classes were combined to produce climatic regions of which there were sixty-three possible combinations. The climatic regions were then used in establishing class levels in the soil capability classification for agriculture. A description of the temperature zones and moisture classes is located in Appendix C.

4. Land Capability Classification for Forestry

The land capability classification for forestry is similar to that of the soil capability classification for agriculture. Expertise in both fields was based on many years of research and practical experience. Forest inventories in the past had been primarily based on timber cruises which measured the amount of merchantable timber in a given area. The forest classification of the Canada Land Inventory was to be based on the capability of a given site to grow commercial timber.

Research into the development of the forestry capability classification was based in part, on work by G. A. Hills of the Ontario Department of Lands and Forests who developed a seven class system for forest evaluation. The guidelines for the classification were developed jointly by the provincial and federal governments and the universities. In 1964, a tentative classification was created and tested in a series of pilot projects. In January of 1965, the forestry classification was adopted by the National Committee on Forest Land.

The national capability classification for forestry is based on the following criteria.

> All mineral and organic soils are classified in one of seven classes, based on an inherent ability to grow commercial timber. The best lands of Canada for commercial tree growth are in Class 1, while those in Class 7 cannot be expected to yield timber in commercial quantities... when assigning land to a given class the environment of subsoil, soil, surface, local and regional climate as well as the characteristic tree species are all taken into account. The capability class, then, is an expression of all the environmental factors as they apply to tree growth... the factors which limit tree growth are shown as sub-classes for all except Class 1. The degree of limitation determines the class designation... the tree species that can be expected to yield the volume associated with each class are shown as part of the symbol. Only indigenous species adapted to the region and land are shown. [83]

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[83] Canada, Department of Regional Economic Expansion, The Canada Land Inventory, Land Capability Classification for Forestry, Report No. 4, Second Edition, 1970. pp. 2 - 3.

Unlike the other capability classifications, a productivity range is associated with each capability class. This range is based on the mean annual increment of the indicator species at or near rotation age and is indicated in gross merchantable cubic feet of timber down to a minimum diameter of four inches. Location, access, distance to markets, size of units, ownership, or present condition are not considered in assigning the capability class. Thus, the classification is designed to enable the comparison of the potential of all land units for timber production, irrespective of their location, vegetative cover or present land use.

In the case of this classification the national capability class descriptions have been modified for the various regions across the country. Class 1 and 2 lands in Alberta are non-existent. This is primarily due to the harshness of the climate which prevents forests from attaining this required productivity. Class 3 is considered to be the highest in the Province and is shown without limitations.

As in the agriculture capability classification land units often have complex ratings where different types of land are so closely inter-related that they are shown as a single unit with the proportion of the unit in each capability class indicated.

Controversy in this classification has centred on the feasibility of establishing a classification which would be consistent across the country. It has been indicated that the rating system is unrealistic because it uses west coast forest capability as the base against which all other lands across Canada are compared. Although this may be true, it applies equally to the other classification, and it is only logical that the best tree growth will occur in coastal British Columbia. A complete listing of the classes and sub-classes is located in Appendix D.

5. Land Capability Classification for Recreation

The 1961 Resources for Tomorrow Conference clearly indicated the need for a recreation capability classification. Unlike the agricultural and forestry classifications, knowledge of recreation classificationswas very limited. The U.S. Outdoor Recreation Resources Review Committee stated that "perhaps no other activity involving so many people and so basic a part of our life has received less attention from qualified investigators and scientists."[84] G. A. Hills in The Ecological Basis for Land-Use Planning describes a seven-point system for the classification of the capability of land for recreational use. Hills points out a major problem which has consistently plagued the classification of recreational land; that is, the subjectivity or value judgements which must be made. "The personal nature of recreation and the subjective manner in which it must be experienced makes it extremely difficult to define." [85]

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[84] United States Department of the Interior, Outdoor Recreation Resources Review Commission, Outdoor Recreation for America, Washington, 1962.

[85] G. A. Hills The Ecological Basis for Land Use Planning, Ontario, Department of Lands and Forests, 1961, p. 114.

The recreation capability classification was developed in 1965 with aid from a committee of the Federal-Provincial Parks Conference. Testing was conducted in the provinces during the summer of 1965 and a national system was agreed to early in 1966.

The objectives of the recreation capability classification have been indicated as follows:

> To provide a reliable and authentic overview of the quality, quantity and distribution of natural recreation resources within the settled parts of Canada.
>
> To indicate comparative levels of recreation capability for non-urban area lands, based on present popular preferences.
>
> To indicate the type of recreation to which land is best suited.
>
> To identify, where possible, lands or features possessing outstanding or unique recreational values.
>
> To provide basic information to aid governments in the formulation of policies and programs related to their function of promotion, development and regulation of lands for recreation.
>
> To provide a mapping framework within which provinces may, within reasonable limits, gather and record data on the physical characteristics of significant recreational resources. [86]

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[86] Government of Canada, Department of Forestry and Rural Development, Canada Land Inventory, ARDA, Field Manual Land Capability Classification for Outdoor Recreation, June, 1967, pp. 4 - 5.

Unlike the other capability classifications, the recreation classification is based on a number of different types of use, and as a result, entirely different types of land may be classified as being of similar capability but for different types of recreational activities.

The other capability classifications list limitations for a particular land use (moisture deficiency is a limitation to tree growth), but the recreation classification lists features on activities which can be sustained by the resource base. Land and water limitations were recorded by some of the provinces in their field surveys but they have been omitted from the published maps. The listed features which are most suitable for recreational use vary according to the particular use. This is noticeable in relation to site-specific recreational use activities which are related to individual land or water features. In the other classifications these site-specific sites would be incorporated into a larger land unit or complexed as in the case of agriculture and forestry.

Around lakes and rivers the shoreline is divided into small segments which indicate capability levels and features. Site-specific upland activities, such as skiing are usually confined to relatively small pieces of land within larger more generalized units.

The recreation capability classification is also based on seven categories. Class 1 areas are relatively scarce and usually confined to prime beach sites. Each land unit is designated as being either shoreland or upland. Actual water bodies, however, are not classified and the recreation value of the water accrues to the adjoining shoreland unit.

The classification was designed to compare land on the basis of its natural capability to provide opportunity for recreational use. Due to the subjectivity involved in rating recreational lands certain assumptions were made in developing the classification. Location and present access did not influence the classification, uniform demand and accessibility conditions were assumed and present use or land management were not considered when rating the land. "The basis of classification is the quantity of recreation which may be generated and sustained per unit area of land per year under perfect market conditions."[87]

Although the recreational capability classification was designed so that it could be compared to the other classifications, this has become difficult to accomplish. The terms and methodology employed in the classification are not easily quantified, and it is virtually impossible to compute a monetary value. Indirect economic values can be formulated for agricultural and forestry lands but the same is not true for recreation. A description of the recreation classes and features can be found in Appendix E.

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[87] *Ibid.*, p. 7.

6. Land Capability Classification for Ungulates

A tentative land capability classification for ungulates was developed in 1964. Wildlife classification research had been minimal and it would be a difficult task to create a classification which would consistently rate capability across the diverse ecological regions of Canada.

The United States Soil Conservation Service had established a classification of soils which was suitable for agriculture. Classes five to eight of this eight-class system were indicated as suited to pasture or woodland and wildlife. In 1963 the same service developed a classification system which rated soils as to their suitability for wildlife habitat. G. A. Hills in The Ecological Basis for Land Use Planning describes a classification system for dryland and wetland wildlife. The dryland capability classification, divided into seven categories, was based primarily on soils. H. J. Dirschl, and S. M. Hugo in 1963 conducted a wildlife habitat evaluation in the Torch River area of Northern Saskatchewan. The prepared forest cover maps were interpreted in terms of wildlife habitat.

The ungulate classification used in the Canada Land Inventory was developed by the Canadian Wildlife Service and provincial wildlife agencies. It was adopted at the Federal Provincial Wildlife Conference in July of 1965. The classification rates land on the basis of its inherent ability to produce and sustain wild ungulate habitat, and land units are classified into seven levels.

Three additional categories are indicated in classes 1 to 3 and identify lands which act as important winter ranges for animals from surrounding areas.

The most favourable conditions for ungulates occur on lands which are rolling and hilly with steep river breaks. These areas provide shelter, edge, accessibility and conditions suitable for the growth and use of browse plant species. Several important considerations are inherent in the classification,

> Capability ratings are established on the basis of the optimum vegetational stage (successional stage) that can be maintained with good wildlife management practices. Capability ratings assigned to not reflect present land use (except in extreme cases such as heavily populated areas), ownership, lack of access, distance from cities, or amount of hunting pressure.[88]

Like the agricultural and forestry classifications the level of capability of a land unit is determined by the existence and severity of a number of limitations. Limitations do not exist in Class I areas. The classification, in addition, indicates the ungulate species most suited to the environmental conditions of each land unit.

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[88] Canada, Department of Regional Economic Expansion, The Canada Land Inventory, Objectives, Scope and Organization, Report No. 1, 1970, p. 37.

The ungulate capability classification, like that of recreation, is difficult to evaluate and compare with the other classifications as it is virtually impossible to assign economic values. A description of the ungulate classes and limitations is located in Appendix F.

7. Land Capability Classification for Waterfowl

Closely associated with the ungulate capability classification, is that of waterfowl. The two classifications were developed at the same time by the same agencies although most of the research in the waterfowl classification was conducted by the Canadian Wildlife Service. G. A. Hills had previously developed a classification for wetland wildlife which in addition to waterfowl included fur-bearing animals such as beaver and muskrat.

In the waterfowl capability classification lands and water bodies are rated according to their ability to produce and provide habitat for various waterfowl species. The classification is based on an assessment of environmental factors and is divided into seven classes. Four special classes which indicate the importance of certain areas for migratory purposes are also included in the highest three classes. In the waterfowl classification, unlike the classifications previously discussed, water surfaces are rated as well as land areas since waterfowl production is directly related to quantity, quality, distribution and type of water bodies.

The class is determined by the severity of limitations for waterfowl production experienced within each individual land or water unit. Limitations do not occur in Class 1 or Special Class 3M areas. Indicator species are not present in this classification as most waterfowl species require similar habitat for optimum production. A description of the classes and limitations can be found in Appendix G.

8. Capability Classification of Fresh Waters for Sport Fish

The sport fish capability classification was not included as one of the original classifications established by ARDA for it was covered as a feature under the recreation capability classification. However, as a sub-class in this classification it did not receive the detail which the resource warranted, and a sport fish capability classification was developed.

As with the other classifications its development was largely based on research conducted by G. A. Hills who had established a classification of fresh water for fish production in Ontario. Developed for the C.L.I. was a classification which contained 4 classes. The complexity of aquatic environments prohibited finer breakdown without considerable increase in expenditure. The ratings were established on the basis of physical, chemical and biological characteristics of the fish habitat. Habitats were initially divided into two groupings; those that would support cold water species (trout, arctic grayling, and mountain whitefish) and those that would support warm water species (northern pike, walleye, perch or goldeye).

Mapping of the sport fish capability classification was conducted according to watersheds and is not spatially oriented to any particular point in the watershed. All lakes of 202 ha. (500 acres) or more and large rivers are assigned separate classification ratings. The classes, with the exception of Class 1 contain limitations. These limitations are divided into two groups, those that apply to streams and those that apply to lakes and reservoirs.

Although the sport fish capability classification contains only 4 classes, the mapping symbols make it more difficult to interpret than the other classifications. To date, it has not received the attention accorded the other classifications which, with the exception of present land use and agro-climates have been produced in coloured map form at a scale of 1:250,000. A description of the sport fish classes and limitations can be found in Appendix H.

In this chapter a brief account of the development of the classifications and the structure of each has been provided. Detailed descriptions on the structures of the classifications can be found in the sector methodology reports that were prepared by the Canada Land Inventory.

In the next chapter an attempt will be made to document the accuracy and reliability of the various classifications.

CHAPTER V

ESTABLISHING RELIABILITY OF CANADA LAND INVENTORY CLASSIFICATIONS

How reliable is the Canada Land Inventory? This question has been asked many times by those who attempt to use it, and resource personnel continually challenge it. It is beyond the scope of this thesis to fully evaluate the level of accuracy involved in the compilation of information for the various classifications; however, it is possible to document some of the concerns expressed by different user groups. The published 1:250,000 map sheets have received wide distribution and more detailed maps have been used in numerous government studies.

In general, the accuracy of the Canada Land Inventory depends upon the level of detail upon which the initial classifications were based and at which they are used. It is virtually impossible for the user to know the first point, and this often leads to misuse of the information. Some land areas covered by the soil capability for agriculture classification were based on comprehensive soil surveys while others were based on reconnaisance surveys. In the recreation capability classification some areas received site inspections while other areas were classed from air-photos or topographic map sheets.

In addition, the accuracy factor is dependent upon the level of expertise of those who conducted the field work and produced the classifications. Most of the field work was conducted during the summer months by university students and their work was often suspected by permanent employees. A degree of animosity developed in some cases between government agencies with their experienced staff and the university students. The C.L.I. programs and their personnel were often viewed as intruders by the government agencies which were unwilling to supply support and expertise. Animosity also developed between the provinces and people in the C.L.I. program which was largely funded and controlled by the Federal government. As a result of these conflicts, provincial agencies have been reluctant to accept the C.L.I. and continually question its validity. The C.L.I. is weak in certain areas due to a lack of experience by those who conducted it, but provincial agencies have themselves to blame because many of them were unwilling to provide initial support to the program.

Much of the criticism of the C.L.I. is aimed at the generalized nature of the classifications. The C.L.I. is general and not site specific, and accuracy levels of the classifications are different and also dissimilar for particular land areas. Many resource personnel depend upon detailed and quantifiable data and this, the C.L.I. does not provide. However, it can serve many useful purposes, if one has an understanding of its reliability. This can best be obtained through experience in utilizing the information and comparing it to other surveys.

1. Reliability of Specific Classifications

(a) Present Land Use

J. B. McClellan, who was largely responsible for the preparation of the Present Land Use Classification in the Geographical Branch in Ottawa, identified several factors which could affect its reliability.

> The greatest problem in applying the classification lies in the interpretation of categories 4 (Cropland) and 5 (Improved Pasture or Forage Crops). Experience at the Geographical Branch and elsewhere has shown that, using photographs taken at various scales and flown at times outside the growing season, the separation between grain and hay is not reliable.[89]

Another concern identified by McClellan relates to productivity.

> Nor do the maps reflect degrees of productivity within categories; the bush pastures of the Lower Fraser Valley in B.C. appear in the same category as the weedy timothy fields of the part-time farmers along the margins of the Canadian Shield.[90]

L. G. Reeds in a paper entitled "The Land-Use Survey of the Niagara Peninsula - A Critical Review" has identified several problems in the land use maps prepared for that region. He feels that the maps do not portray the complexity of land use patterns which exist in the fruit belt.

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[89] McClellan, op. cit., p. 77.

[90] *Ibid.*, p. 77.

> Vineyards, horticulture and tree fruits cannot be mapped satisfactorily in certain local areas because of the common practise of inter-culture of crops. A few rows of cherry trees may occupy a roadside location with vineyards behind. Vegetables may be grown as inter-row crops in young orchards.[91]

Reeds feels that the 1:50,000 map scale is too small for mapping complex land use patterns in the Niagara fruit belt, and he employed a scale of 1:8,000 in re-mapping part of the region. The larger the scale of the map, the more detailed it can become; however, detail often must be sacrificed, as in the case of the C.L.I. because of time and expense. Reeds also identified a problem which is common to all of the classifications. "Since the field worker makes many generalizations daily and since several observers were involved, interpretations varied considerably."[92] Although this is certainly a problem it could be partly eliminated with close supervision of the staff.

The accuracy of the mapping also depended upon the size of the parcels that were classified. In Alberta mapping was taken down to 2.4 hectare (6 acre) parcels while in Saskatchewan the minimum unit is reported to have been 65 hectares (160 acres).

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[91] L. G. Reeds, "The Land-Use Survey of the Niagara Peninsula - A Critical Review," Geographical Bulletin, 7(324), 1965, p. 204.

[92] *Ibid.*, p. 204.

Air photographs presented some problem in the present land-use classification. Present land use in Alberta was mapped from air-photographs which were taken over a fifteen year period; yet for most of the settled areas the time frame was much shorter. The date, or time of year also had a significant effect on the accuracy of the maps.

> Those taken either too early or too late in the growing season lack much of the detail that greatly facilitates direct mapping. Woodlands without leaf cover appear deceivingly open and stunted in growth; thus productive woodland is easily confused with the non-productive category.[93]

In Spring photography it is virtually impossible to differentiate between grain and fodder crops for the fields have been freshly cultivated and appear the same. The same problem occurs in the Fall after harvesting. In Alberta this is a major problem in the agricultural fringe areas where most photography is flown in the Spring or Fall.

As in the other classifications marginal types of land units were difficult to interpret from photographs. "Numerous bush-covered muskeg areas for example, could conceivably be classed either as wetland or unproductive woodland."[94]

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[93] C.L.A. Hutton, "Mapping Present Land Use in Alberta...an ARDA project," The Albertan Geographer, Department of Geography, University of Alberta, No. 2, 1965-66, p. 35.

[94] *Ibid.*, pp. 35-36.

Fluctuating water levels and amount of ground moisture also presented problems to those classifying present land uses. In wet years, sloughs would be higher than normal, and the amount of surface water would thus vary depending upon the year and season of photography. This also presented problems in the other classifications especially for waterfowl and recreation.

An additional concern which limits the reliability of the present land use classification relates to its mapping. The classification was often mapped from air photos by inexperienced personnel who, in some cases lacked expertise in air photo interpretation. The interpretation problems which have been identified would certainly have led to some mistakes since only a minimum of field-checking was conducted. Although most mistakes would not be major, I do recall a particular situation in Ottawa where tobacco crops in Northumberland County in southeastern Ontario, were mapped as corn fields by inexperienced personnel.

The concerns indicated above of course do not apply to all of the present land use classification programs. In Alberta the geography students involved in the program had considerable training in air photo interpretation. Stability in the classification was maintained as most of the students worked on the program for two or three years, and this also helped in ensuring accuracy of the mapping. In some of the other provinces portions of the classification were assigned to private consultants while both government and university departments hired summer staff to complete others. Consistency was impossible to maintain.

(b) Soil Capability Classification for Agriculture

The soil capability classification for agriculture has probably received more comments about its reliability than any of the other classifications. One of the reasons is that it is utilized to a greater extent and for more purposes than the other classifications. Most of the controversy centres around the level of detail of the classification. In Alberta the classification is more reliable in areas where it is based on detailed soil surveys. In some of the fringe areas of the province, the classification is based on reconnaissance surveys and lacks detail. Many agencies have attempted to use the classification for specific purposes which deal with small acreages, and this is where problems occur for it is not accurate at the management level of planning. In fact, it is often challenged at the regional level.

J. T. Wilson, in a thesis prepared for the Geography Department of the University of Alberta, has evaluated the feasibility of using the soil capability classification in land use planning at the regional level. Mr. Wilson evaluated, in a test area of northeastern Saskatchewan, the original classification for each quarter section which had been recorded on municipal assessment sheets. These sheets showed the various soils of the quarter section with a high degree of accuracy. This information was then compared to the published 1:250,000 C.L.I. maps.

> In more than 15% of the cases, the original soil classification of the quarter section and the soil classification on the published 1:250,000 maps differed. Some of these differences appeared to be errors in transcription while others were the result of the generalization necessary on the smaller scale published maps. 95

This statement gives us very little information as to the reliability of the classification and no distinction is made between errors in transcription and generalization. In fact, just about all of the 1:250,000 maps published across the country have been generalized. On these maps, sub-class (S) adverse soil characteristics,replaces (D) undesirable soil structure and/or low permeability, (F) low fertility, (M) moisture limitation and (N) salinity either individually or collectively from the more detailed field maps.

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[95] J. T. Wilson, An Economic Evaluation of Extending Agriculture in Northeastern Saskatchewan, Thesis, Geography Department, University of Alberta, 1972, p. 49.

Mr. Wilson in his thesis claims that

> just as there is no direct relationship between crop acreages and soil capability groups, there is none between the percentage of improved and unimproved land and the capability groups. Had soil quality been an important factor in determining land use one would have expected the amount of improved land to decrease with decline in soil capability but no such relationship was found. [96]

The premise expressed in the above thesis is further emphasized in a paper by Proudfoot and Wilson presented at a Symposium on the Lakes of Western Canada held in 1973.

> Taking into account fluctuations in market prices and expectations no correlation between crop and soil capability class need be expected. According to the information supplied by farmers variations inyield on different soils were of little significance. [97]

Their views are again presented in a paper presented to the British Association for the Advancement of Science in 1974.

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[96] Ibid., p. 52.

[97] B. Proudfoot and J. T. Wilson "An Evaluation of Expanding Agriculture in the Saskatchewan River Delta of Northeastern Saskatchewan". Proceedings: Symposium on the Lakes of Western Canada, Edmonton, 1973, p. 109.

> In conclusion, our data suggest that the C.L.I. data for Soil Capability for Agriculture, grouped to take account the varied nature of soils as they occur under actual conditions, provides limited information on the capability for an area to support profitable farming. To achieve better use of land and to provide an accurate inventory of resources for agriculture, specific data on the physical environment of individual farms, their actual production, and the net return on the various goods produced are needed.[98]

The study area chosen by Wilson is certainly not characteristic of the Prairies. In the area's cool, humid marginal lands, it appears that artificial drainage, frost patterns, distance from good transport facilities, et cetera, may have played greater than usual roles in agricultural success. These factors may have outweighed those of soil capability. More detailed data should have been provided to back up the conclusions which appear to be largely subjective.

Although both Proudfoot and Wilson feel there is little difference in the productivity levels of soil capability classes a study in Ontario indicates the opposite. This study conducted by D. W. Hoffman at the University of Guelph was designed to investigate quantitative ratings of soil capability classes based on the yield of various field crops. Over 1,000 sites scattered across southern

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[98] P. Proudfoot and J. T. Wilson, Land Capability, Farm Production and Profit, British Association for the Advancement of Science, Stirling, 1974, p. 6.

Ontario were used for statistical analysis.

The results obtained from the study are indicated in table 18.

TABLE 18

CROP YIELDS BY AGRICULTURAL CAPABILITY CLASSES

Corn Yields by Class

Class	1	2	3	4
No. of Observations	170	258	64	7
Bushels/Acre	136 ± 13.3	105 ± 10.5	80 ± 9.8	59 ± 8.1
Indices	1.00	.77	.59	.43

Oats Yields by Class

Class	1	2	3	4
No. of Observations	51	39	20	13
Bushels/Acre	90 ± 7.2	73 ± 5.2	62 ± 4.5	52 ± 7.5
Indices	1.00	.81	.69	.58

Barley Yields by Class

Class				
No. of Observations	40	29	37	16
Bushels/Acre	81 ± 9.5	67 ± 6.8	52 ± 7.1	38 ± 4.6
Indices	1.00	.83	.64	.47

TABLE 18...continued

Performance Indices for Soil Classes 1 to 4 for Common Field Crops

Class	Index	Range
1	1.00	-
2	.80	.80 ± .03
3	.64	.64 ± .04
4	.49	.49 ± .06

Source: D. W. Hoffman, The Assessment of Soil Productivity for Agriculture

Classes 5,6 and 7 were not sampled as it was found that farmers seldom cultivated these areas.

J. S. Anderson from the University of Guelph developed indices based on forage yields.

> His indices are essentially the same for classes 1, 2 and 3 but his index for class 4 is slightly higher...His results show no significant difference between classes 4 and 5 nor between classes 5 and 6. There is a significant difference between classes 4 and 6.[99]

The findings of Hoffman and Anderson clearly indicate a correlation between capability class and productivity, and the reliability of the classifications appears to be greater than that considered by

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[99] D. W. Hoffman, The Assessment of Soil Productivity for Agriculture, Department of Land Resource Science, University of Guelph, Guelph, Ontario, 1971, p. 41.

Proudfoot and Wilson.

In two other Ontario studies, H. F. Noble developed performance indices for soil capability classes which were based on labour income from dairy farms, and the Committee on Farm Assessment and Taxation developed indices which were based on the market value of farm properties. Noble's study was based on 299 farms located in Eastern Ontario, and he stated that "acreages of the different soil classes on each farm unit should give an estimate of the potential productivity of the soil on each farm or of the potential difficulties encountered by the farmer to obtain saleable products."[100]

The performance indices derived from the four Ontario studies are indicated in table 19.

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[100] H. F. Noble, An Economic Classification of Farms. Ontario Government, Department of Agriculture and Food, Toronto, 1965, p. 5.

TABLE 19

COMPARISON OF PERFORMANCE INDICES

Soil Capability Class	Hoffman-Arable Crop Yield	Anderson Forage Yield	Noble Adjusted Acres	Market Value (Farming)
1	1.00	1.00	1.00	1.00
2	.80	.80	.87	.92
3	.64	.66	.75	.72
4	.49	.58	.33	.30
5	no value	.53	.25	.15
6	no value	.44	.20	.10
7	no value	no value	no value	.07

Source: D. W. Hoffman, The Assessment of Soil Productivity for Agriculture

Although the indices are fairly consistent in classes 1 to 3, Hoffman and Anderson's figures for class 4 to 7 differ from those of Noble and the Committee on Farm Assessment and Taxation. Hoffman feels that his figures and those of Anderson are more reliable than the figures of Noble and the Committee on Farm Assessment and Taxation which were not directly related to the soil's ability to produce crops. "It is suggested that the performance indices prepared in this study and in Anderson's are superior in producing information on differences in physical capability for crop production because measurements made were directly related to crop production." [101]

Since 1970, the Resource Economic Branch of the Alberta Department of Agriculture has produced a series of annual reports entitled Rural Real Estate Values in Alberta. These reports provide information on the amount of agricultural land in Alberta sold in a given year, its average selling price, and the soil capability of the land. The land values as they relate to agricultural capability over the six year period provide data which can be used in establishing the reliability of the soil capability classification for agriculture. (see table 20).

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[101] Hoffman, op. cit., p. 48.

TABLE 20

AGRICULTURAL VALUES IN RELATION TO C.L.I. RATINGS

Agricultural Capability Rating	No. of Observations 1970	Average Value/Acre 1970
1	33	$ 83.19
2	343	63.98
3	377	53.00
4	381	40.17
5	178	42.97
6	79	44.26
7	18	63.05
0(organic)	38	40.05
	1971	1971
1	336	103.58
2	1,504	74.17
3	2.053	62.43
4	1,598	44.71
5	625	49.27
6	401	42.29
7	78	45.60
0(organic)	122	42.06

TABLE 20...continued

Agricultural Capability Rating	No. of Observations 1972	Average Value/Acre 1972
1	419	$215.98
2	1,921	89.91
3	2,595	69.91
4	2,028	53.66
5	944	70.94
6	337	63.94
7	63	61.24
0(organic)	95	44.79
	1973	1973
1	579	148.28
2	2,630	103.35
3	3,717	84.66
4	3,115	61.66
5	1,300	68.83
6	431	73.40
7	74	80.04
0(organic)	42	64.12

TABLE 20...continued

Agricultural Capability Rating	No. of Observations 1974	Average Value/Acre 1974
1	599	$ 196.21
2	3,797	143.06
3	4,926	106.81
4	3,427	81.90
5	1,521	98.19
6	482	94.57
7	86	77.66
0(organic)	178	82.06
	1975	1975
1	813	257.40
2	3,827	175.74
3	4,907	145.87
4	3,541	112.27
5	1,654	133.17
6	652	124.52
7	216	100.72
0(organic)	308	95.82

TABLE 20...continued

Agricultural Capability Rating	No. of Observations 1976	Average Value/Acre 1976
1	Not Available	$342.69
2	Not Available	215.07
3	Not Available	174.43
4	Not Available	143.78
5	Not Available	152.31
6	Not Available	137.48
7	Not Available	140.22
0(organic)	Not Available	134.46

Source: Resource Economics Branch, Alberta Department of Agriculture, Rural Real Estate Values in Alberta, 1970-1976.

> The data in Classes 1 to 4 indicate a definite decline in value as the soil rating declines. Comparison of the average values for the least productive soils (Classes 5 to 7) and the most marginal crop land (Class 4), suggests the involvement of considerations other than agricultural productivity...Values for Class 5, 6 and 7 land reflect levels above the expected average values when only considering agricultural capability. The additional value stems from its use for timber, recreation, wildlife or other agricultural uses.[102]

The values would also include any buildings on the land and this would tend to increase the average value per acre in the lower capability ratings. In addition, these values would be relatively high near urban areas where the land has been sub-divided for country residential purposes.

Studies by D. W. Hoffman of the Centre of Resources Development of the University of Guelph, in the development of performance indices for soil Classes 1 to 4, have shown consistent productivity levels for common field crops. The studies show a 20% drop in efficient productivity between Class 1 and 2 and a 50% drop between Class 1 and 4. If one assumes that the real estate values of Classes 1 to 4 lands in Alberta reflect the productivity of those lands, similar results to those of Hoffman are obtained as indicated in table 21.

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[102] Alberta, Department of Agriculture, Resource Economics Branch, 1976, Agricultural Real Estate Values in Alberta, 1977, p. 18.

Although the figures do not show a conclusive relationship they do bear a resemblance to those productivity decreases shown by Hoffman. The soil capability ratings were designed to be consistent across Canada but there is no documented evidence to show that this is true. Therefore, it is not known if Hoffman's productivity levels will apply to Alberta. In addition, it may not be valid to compare productivity levels to real estate values due to the number of external factors which affect the latter.

The Land Use Assignment Branch of the Alberta Department of Lands and Forests has argued that the Canada Land Inventory and specifically the Soil Capability Classification for Agriculture is not sufficiently detailed for land use planning. The Branch believes that a biophysical land classification which differentiates and classifies ecological units is required in place of the Canada Land Inventory. In utilizing the soil capability data the Land Use Assignment Branch has altered, usually downward, many of the ratings.

This has been opposed by others who believe that the ratings are fairly accurate. C. W. Harke of the Lands Division of Alberta Lands

TABLE 21

PERCENTAGE DECREASE IN VALUE BETWEEN SOIL CAPABILITY CLASSES IN ALBERTA

Year	Average Value Per Hectare (Acre) Class 1	Average Value Per Hectare (Acre) Class 2	Average Value Per Hectare (Acre) Class 4	% Decrease Between Class 1 & 2	% Decrease Between Class 1 & 4
1970	207.98 (83.19)	159.95 (63.98)	100.43 (40.17)	23.09	51.17
1971	257.50 (103.58)	185.43 (74.17)	111.78 (44.71)	28.39	56.83
1972	314.95 (125.98)	224.78 (89.91)	134.15 (53.66)	28.63	57.41
1973	370.70 (148.28)	258.38 (103.35)	154.15 (61.66)	30.30	58.42
1974	490.53 (196.21)	357.65 (143.06)	204.75 (81.90)	27.09	58.26
1975	643.50 (257.40)	439.35 (175.74)	280.68 (112.27)	31.72	56.38
1976	856.73 (342.69)	537.58 (215.07)	359.45 (143.78)	37.24	58.04

Average percentage decrease between Classes 1 and 2 1970-76 is 29.49

Average percentage decrease between Classes 1 and 4 1970-76 is 56.72

and Forests has indicated the following:

> It is the opinion of the writer that the Canada Land Inventory Ratings of Soil Capability for Agriculture for the study area generally are within the limits of the guidelines for the establishment of the ratings. It must be recognized that these ratings are based on a reconnaisance-type survey and therefore one can expect to find some variations between the maps and sample plots.[103]

Detailed review by soil scientists would be required to establish the reliability of the Soil Capability Classification for Agriculture and it would undoubtedly vary from area to area and from site to site. It would be impossible to ever reach a concensus of opinion on the matter. However, everyone will agree that it does provide a wealth of soils information which was previously non-existent.

(c) Land Capability Classification for Forestry

The Forestry Capability Classification is considered less suspect than the other classifications for it was based on quantitative productivity (cubic feet per acre per annum). However, the figures in most cases were estimates based on representative sample plots. The process was fairly subjective, and while based on landform classes, differed according to the amount of detail considered necessary by the interpreter.

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[103] C. W. Harke, Sturgeon Lake Study Review, Lands Division, Department of Lands and Forests, Alberta, 1973.

Research conducted by Northwestern Pulp and Power in Hinton, Alberta, indicated that the Canada Land Inventory productivity figures were close to those that were calculated using their own methods. In cases where the figures differed it was found that the C.L.I. estimates were on the conservative side.

A major criticism of the forestry classification is that it uses British Columbia coastal forests as the base against which all other forest lands across the country are compared. It is felt that this results in an unrealistic rating system since the majority of forest lands in Canada are of a much lower capability. In fact since the forestry capability in the Coastal and Columbia forest regions of British Columbia is so high, class 1 has been sub-divided into several categories (class 1a - 131 to 150 cubic ft./acre/year, class 1b - 151 to 170, class 1c - 171 to 190, class 1d - 191 to 210 and class 13 - 211 to 230).

As with the agricultural classification the Land Use Assignment Branch of Alberta Lands and Forests has questioned the validity of the forestry classification. J. Lowe of the Alberta Forest Service in response to this question evaluated some ratings in the Sturgeon Lake area of Alberta.

> The capability ratings are reliable and are generally conservative by about 1/3 of a class or 13% of the sample's map average productivity potential. This result agrees very closely with a 1971 study of 81 stocked coniferous plots on Proctor and Gamble's limit where C.L.I. map forestry capability ratings were found to predict pulp (cubic feet/acre/year) conservatively by about 20%.[104]

The forestry classification has received very little public exposure as most of the lands classified across the country have been under Crown ownership and not available for disposition. The public has therefore not been concerned about the accuracy of the classification. It has also not been of major interest to foresters who are more concerned with existing stocks of merchantible timber than with potential as expressed in the forestry classification.

(d) Land Capability Classification for Outdoor Recreation

Criticism of the recreation capability classification has centred on its subjectivity. This subjectivity relates both to the design of the classification and the methods by which the field work for it was conducted. "Under this classification, the role of each quality criterion in contributing to the final classification is not made explicit, which thus introduces subjectivity for deriving the final classification." [105]

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[104] J. J. Lowe, Forester, Inventory Surveys Section, correspondence to F. W. McDougall, Head Timber Management Branch, Alberta Forest Service, November 6, 1973.

Quantitative criteria have,however,been utilized in rating some of the features. A class 1 beach must be situated on a water body of at least 15.6 square kilometres (6 square miles) in area, or 16.1 kilometres (10 miles) in length, the beach gradient must be between two and five percent, the beach must be at least 305 metres (1,000 feet) in length, and there must be 10.1 hectares (25 acres) of developable backshore. Similarly, a class 1 ski area must have a vertical drop of at least 610 metres (2,000 feet) and a developable area of at least 40.5 hectares (100 acres) at the base.

The rating of such a feature as viewing is highly subjective and relates to the viewing point and not the feature being viewed. The site of the Chateau Lake Louise Hotel is rated a class 1, outstanding viewing spots along the Gaspe Peninsula, the Cabot Trail and the north shore of Lake Superior class 2, and outstanding viewing locations along the Niagara Escarpment and Qu'Appelle Valley class 3.

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[105] Prem Kumar Land Capability Assessment - Outdoor Recreation, Term Paper, Geography 566, University of Alberta, February 1973, p. 4.

The reliability of the sub-class features associated with the various capability classes has receeived considerable discussion. A maximum of three features are listed with each class unit with the first feature being the dominant one and the other two in descending order of importance. However, one never really knows the importance of these subordinate features. Many areas, especially those in the lower classes, do not have enough features to justify subordinate symbols and the second and third ones are often meaningless. In many class 4 and 5 shoreline units with N (cottaging) as the dominant feature, the subordinate features are always Y (boating) and A (angling). It appears that it was just a routine matter to fill in Y and A as subordinate features, and they don't really tell us anything regarding the capability of the lake to support these activities.

The sub-classes (features) are really insignificant in the lower capability classes. Most of the agricultural lands in Alberta received a class 6, with P (cultural landscape) dominant and with two of O (upland wildlife) W (wetland wildlife) or E (vegetation) as subordinate.

The Canada Land Inventory has recognized the problem associated with subordinate features and the following inscription has been placed in the legend of the published 1:250,000 map sheets.

> The degree to which these features are judged capable, collectively, of generating and sustaining use for recreation, determined the class. The sequence in which they are listed indicates the order of their significance. Subordinate features may be relatively insignificant and the class of a unit should not be interpreted to indicate the capability of a secondary or tertiary feature.[106]

The ability of field staff to evaluate upland and shoreland units with consistency was a major concern to C.L.I. officials during the preparation of the classification. It was difficult enough for an individual to be consistent in his/her own ratings let alone being consistent with the ratings of others across the country. Pilot projects conducted in 1965 indicated problems in distinguishing between class 4 and 5 lands. This is especially true in the case of shorelands. One individual or even province could have rated a particular type of shoreland class 4 while another group rated similar shoreland in another location class 5. In both Saskatchewan and Alberta the field work was conducted by geography students and the core of the group were involved with the classification for several years, and thus helped to maintain consistency. This was not the case in other provinces where portions of the classification were contracted to consultants.

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[106] Canada, Department of Environment, Canada Land Inventory, Land Capability for Recreation, Tawatinaw 831, 1971.

Neither Saskatchewan nor Alberta was completely problem free as both had administrative concerns. In Saskatchewan the university students engaged in the recreation classification were employed by the Department of Natural Resources but worked through the Geography Department of the University of Saskatchewan. Difficulties associated with having two 'bosses' were evident. In Alberta the recreation classification was initiated in the Geography Department of the University of Alberta and then transferred to the Parks Branch of the Provincial Department of Lands and Forests. Such a change resulted in a number of bureaucratic problems.

The accuracy of the classification is partially dependent upon the techniques used in rating the land. Most upland areas were evaluated from air photographs and soil maps which indicated physiographic units. This method of analysis probably led to a number of errors, but they would not be considered serious since most of the upland areas are located in the lower classes. Higher class areas were site inspected; however, many were obviously missed for it was impossible to have a detailed knowledge of the diverse variety of upland features being considered in the classification.

Emphasis was placed on the shoreland portion of the classification and summers were spent in the field mapping of these lands. However it is this portion of the classification which is subject to suspicion because some lakes were classified from air photos and did not receive site inspections. Obvious mistakes were made by inexperienced interpreters. Bear Lake, a small lake north of Edson was classed as upland even though it had a public campground and a twenty cottage subdivision. From air photos, the lake appeared to be too small and shallow to support recreational activities. Vandersteen Lake north of Lesser Slave Lake was classed as having three class 1 beaches and five class 2 beaches. A subsequent field investigation identified most of these beaches, which had appeared on the photos to be composed of sand, to be in fact gravel, and thus they warranted a lower class. In thoseareas of the province where the shorelands were field inspected the classification appears to be quite accurate.

In Saskatchewan, detailed field work was conducted in the rating of shorelands. Prior to actual classification the shoreland was divided into backshore, foreshore and offshore units. These units were marked on air photos with symbols indicating qualities which could limit development. Limitations included such factors as steep slopes, width of foreshore, presence of backshore lagoons, roads and railways, accumulation of organic debris on beach, offshore depth and slope, submerged or emergent reefs, fluctuating water levels, water temperature, water quality, offshore, foreshore and backshore materials, backshore drainage and vegetation. These conditions were then consolidated into a final capability class with associated features. The procedure resulted in a reliable and accurate classification of Saskatchewan shorelands in those areas where the classification was conducted.

Although the recreation capability classification was based on subjective criteria it has proven to be quite accurate at the level of detail for which it was intended. Subsequent detailed investigation of specific sites has resulted in revisions but this is to be expected in any of the classifications.

(e) Land Capability Classification for Ungulates

Some controversy exists over the accuracy of the ungulate capability classification. Most of this centres on the method of analysis employed in conducting the classification. One of the major problems which has plagued the Alberta classification has been the number of staff turnovers which have occurred since the project began. This has led to inconsistencies in classification. In addition, the classification was subject to a major discontinuity. The first series of maps to be completed were analyzed in terms of the soil capability for ungulate fodder and browse while latter maps were prepared using the concept of best natural habitat. Areas in the McLeod valley south of Whitecourt which were originally classed as 1W were later changed to class 3W.

Field work involved the establishment of sample plots near access roads in which amount of vegetative cover, soil moisture, vegetative composition, succession stage and the type and nature of the climax stage were analyzed. Key physio-biotic regions such as muskegs, south facing slopes, river valleys and flood plains were identified from air photographs.

A major problem with the classification resulted from the lack of data on the remote areas of the province where it was unfeasible to conduct field studies. In these cases, the capabilities had to be determined alone from air photographs. Additional problems arose in determining the severity of limitations associated with a particular area due to the absence of climatic data and information on average snow depth, the nature of the snow and date of melting in heavy snow winters.

Attempts to class existing agricultural lands also presented problems. The classification was to be in terms of natural vegetative climax conditions which were often impossible to determine. This component of the classification appears to be rather meaningless as it is unlikely that farmland would be reverted for wildlife. These statements suggest that complementary land use is not possible.

Much of the ungulate capability classification was based on subjective judgements which were made from air photographs. In Manitoba an attempt was made to rate deer densities to capability class as illustrated in table 22.

TABLE 22

RANGES OF WHITE-TAIL DEER DENSITIES CORRESPONDING TO WILD UNGULATE CAPABILITY CLASSES IN MANITOBA

Capability Class	Range of Deer Densities (deer/sq. mile)
1	31 to 42
2	21 to 30
3	13 to 20
4	7 to 12
5	3 to 6
6	less than 2
7	0

Source: Manitoba Department of Mines and Natural Resources, Shellmouth Designated Reservoir Area Proposed Land Use Plan, 1969.

The ungulate classification has not received as much criticism as some of the other classifications. There are two important reasons for this. Firstly, it has not been utilized to the extent the agricultural and recreation classifications have been, and hence, there is less chance for criticism. Secondly, the classification has been used primarily by resource agencies in government who are well aware of its limitations.

(f) Land Capability Classification for Waterfowl

Minimal information is available on the reliability of the waterfowl capability classification; however, it does have several factors in its favour. All waterfowl capability classifications conducted across Canada were completed under the direction of the Canadian Wildlife Service. In Alberta only three individuals were involved in determining the ratings thus, reducing the chance for conflicts. The broad nature of the classification would also tend to reduce the number of errors. Most areas were quite large except for some of the higher capability migration stops, and these were probably well known by the Canadian Wildlife Service.

The classification was completed by an agency with a long history of detailed studies in wildlife, and it is to be expected that the capability maps provide factual information.

(g) Capability Classification of Fresh Waters for Sport Fish

It was not possible to obtain information as to the reliability of the sport fish classification. The classification relies primarily on the physical and chemical properties of the environment, and although these are quantifiable it is beyond the scope of this study to verify them. Maps of this classification at the 1:250,000 scale have not been produced and as a result the classification has received very little public exposure.

2. Interrelationships Between Classifications

(a) Comparison of Agriculture and Forestry Capability Classes

In the comparison of capability classifications it has often been indicated that a specific class would be equal in the five classifications. It is difficult to compare agriculture to recreation, but such comparisons might be valid between agriculture and forestry. The Land Use Planning Data Bank of Alberta Municipal Affairs was, therefore, utilized to determine the number of quarter sections in the agricultural and forestry capability classifications which had the same class. Only the first class of the complex was searched. The study area covered all those quarter sections in Alberta that had both agricultural and forestry capability ratings and this numbered approximately 250,000.

Although very little can be proven by the figures in table 23, they do indicate that approximately 35% of the quarter sections that have agriculture and forestry ratings have identical class ratings. Significant correlations occur in classes 4 and 5, but a surprising 84% occurs between forestry capability class 7 and agriculture capability class 7 or 0 (organic). This latter point tends to confirm the accuracy of both classifications in identifying both muskeg and barren lands.

(b) Comparison of Present Land Use Categories with Capability Classification Classes

During the formation of Alberta Municipal Affairs' Land Use Planning Data Bank, Canada Land Inventory Present Land Use information was coded for portions of the Calgary and Medicine Hat Regional Planning Commissions and portions of the Lesser Slave Lake and Hinton-Yellowhead areas. To further evaluate the level of accuracy of the capability classifications, the classification ratings were compared to the present land use for each of the approximate 100,000 quarter sections in the study area.

The test was intended to establish the relationship between the present land use classification and the capability classifications. The first class in each present land use category and capability classifications was searched and the number of quarter sections for each capability class (rating) which corresponded to a particular land use was recorded.

TABLE 23

COMPARISON OF AGRICULTURE AND FORESTRY RATINGS

No. of Quarter Sections with Agriculture & Forestry	Class	No. of Quarter Sections with Identical Ratings	Percentage with Identical Ratings
-	1	-	-
-	2	-	-
31,984	3	1,979	6.19
117,162	4	46,967	40.09
60,963	5	20,412	33.48
17,436	6	1,433	8.20
20,740	7*	17,523	84,49
248,285 Total		88,314	

*The class 7 category in Agriculture also includes class 0 (organic soils)

Comparison of P.L.U. Outdoor Recreation and Recreation Capability

In the outdoor recreation category for present land use 276 quarters of 409 (67.5%) were located on outdoor recreation class 4 capability land. (see table 24). The outdoor recreation present land use category includes golf courses, parks, beaches, summer cottage areas, game preserves and historical sites. No specific conclusions can be derived from these results; however, this is to be expected since some of the outdoor recreation categories of present land use are not directly related to high capability lands.

TABLE 24

PRESENT LAND USE CLASSIFICATION (OUTDOOR RECREATION) COMPARISON WITH RECREATION CAPABILITY

	Outdoor Recreation No. of Quarter Sections	%	Corresponding Recreation Capability Ratings
	0	0	1
	34	8.3	2
	16	3.9	3
	276	67.5	4
	72	17.6	5
	11	2.7	6
	0	0	7
Total	409		

It is unfortunate that the number of quarter sections of each capability class in the study area was not recorded for it then would have been possible to see what percentage of the high capability recreation lands were being used for recreation. This statement applies equally to the subsequent tests which are described, as it would have been useful to know the total number of quarter sections of each capability class in the study area. Unfortunately due to changes in systems personnel in Alberta Municipal Affairs it was not possible to conduct this additional research.

Comparison of P.L.U. Cropland with Agriculture Capability

Of the 31,267 quarter sections classified under the present land use classification as cropland 29,711 (95%) are located on agricultural capability class 1 to 4 lands. These figures clearly illustrate that croplands in the study area are located on the higher agricultural capability lands. (see table 25).

TABLE 25

PRESENT LAND USE CLASSIFICATION (CROPLAND) COMPARISON WITH AGRICULTURE CAPABILITY

Agriculture A(Cropland) No. of Quarter Sections	%	Corresponding Agricultural Capability Ratings
3,997	12.8	1
6,696	21.4	2
11,078	35.4	3
7,940	25.4	4
1,222	3.9	5
269	.9	6
42	.1	7
23	.1	0
Total 31,267		

Comparison of P.L.U. Cropland with Forestry Capability

Only 3,099 quarter sections which were classified as cropland had forestry ratings and 60% had forestry ratings of class 7. This last figure is rather unusual for land that is suited to crops in most cases is also suited to forest production. The 25% with class 4 forestry ratings appears reasonable; however, it is difficult to comprehend why 60% of the cropland has a forestry rating of 7. Usually class 7 in forestry, in Alberta, indicates muskeg.

TABLE 26

P.L.U. AGRICULTURE (CROPLAND) COMPARISON WITH FORESTRY CAPABILITY

A(Cropland)

No. of Quarter Sections	%	Corresponding Forestry Capability Ratings
127	4.1	3
759	24.5	4
285	9.2	5
87	2.8	6
1,841	59.4	7
3,099 Total		

Comparison of P.L.U. Improved Pasture and Forage with Agriculture Capability

Only 2.2% of the quarter sections in the study area were classified as improved pasture and forage crops. Fifty-five percent of these had corresponding agricultural ratings of class 1 to 3 which indicates that 1088 quarters would be better suited to the production of crops. Four hundred and seventy seven quarters had a class 4 rating and would be marginally suited to crop production. The figures in table 27 indicate that most of the quarters in this category of land use would be suited to a higher agricultural use.

TABLE 27

P.L.U. AGRICULTURE (IMPROVED PASTURE & FORAGE) COMPARISON WITH AGRICULTURE CAPABILITY

P(Improved Pasture & Forage Crops) No. of Quarter Sections	%	Corresponding Agricultural Capability Ratings
97	27.7	1
350	17.9	2
633	32.3	3
477	24.4	4
361	18.4	5
31	1.6	6
1	0	7
7	.4	0
1,957		

Comparison of P.L.U. Improved Pasture & Forage with Forestry Capability

Of the 1,957 quarters classified as improved pasture and forage crops 758 (38%) had forestry ratings and almost 60% were class 7. As in the example where cropland and forestry capability were compared the high percentage of class 7 land appears unrealistic. In table 23 a high correlation has been indicated in class 7 between agriculture and forestry. Possibly low lying haylands located on poor soils have been incorrectly classified as cropland and improved pasture. There could be several other reasons and detailed research would be required to explain the figures.

TABLE 28

P.L.U. AGRICULTURE (IMPROVED PASTURE AND FORAGE) COMPARISON WITH FORESTRY CAPABILITY

P(Improved Pasture and Forage Crops) No. of Quarter Sections	%	Corresponding Forestry Capability Ratings
21	2.8	3
138	18.2	4
95	12.5	5
59	7.8	6
445	58.7	7
758		

Comparison of P.L.U. Improved Pasture & Forage with Ungulate Capability

All of the quarter sections classified as improved pasture and forage crops had corresponding ungulate capability ratings. Only 5.3% had ungulate ratings of class 1 and 2 which indicates that there is little conflict between the agricultural land use and ungulate summer habitat potential in the study area.

TABLE 29

P.L.U. AGRICULTURE (IMPROVED PASTURE & FORAGE)
COMPARISON WITH UNGULATE CAPABILITY

P(Improved Pasture & Forage Crops)

No. of Quarter Sections	%	Corresponding Ungulate Capability Ratings
8	0.4	1
96	4.9	2
634	32.4	3
630	32.2	4
589	30.1	5
0	0	6
0	0	7
1,957		

Comparison of P.L.U. Rough Grazing & Range with Agriculture Capability

Approximately 42% of the quarter sections in this category have corresponding agricultural ratings of class 5, and 86.4% ratings of 4-6. Thus, the rough grazing in the study area appears to be taking place on lands of suitable capability. (see table 30).

TABLE 30

P.L.U. AGRICULTURE (ROUGH GRAZING & RANGE) COMPARISON WITH AGRICULTURE CAPABILITY

K(Rough Grazing and Range Land) No. of Quarter Sections	%	Corresponding Agriculture Capability Ratings
153	.5	1
688	2.2	2
2,602	8.3	3
9,452	30.2	4
13,114	41.9	5
4,489	14.3	6
693	2.2	7
111	.4	0
31,302		

Comparison of P.L.U. Rough Grazing & Range with Forestry Capability

Only 3,644 quarters in the rough grazing and range land category have corresponding forestry ratings. Most of these are class 7 which indicates there is little conflict between this agricultural land use and forestry capability. The figures in table 31 appear to be much more realistic than those indicated in table 26 and 28. One would anticipate that rough grazing would be prevalent on class 7 forestry lands.

TABLE 31

P.L.U. AGRICULTURE (ROUGH GRAZING & RANGE) COMPARISON WITH FORESTRY CAPABILITY

K(Rough Grazing and Range Land) No. of Quarter Sections	%	Corresponding Forestry Capability Ratings
23	.6	3
327	9.0	4
641	17.6	5
317	8.7	6
2,336	64.1	7
3,644		

Comparison of P.L.U. Rough Grazing & Range with Ungulate Capability

Of the 31,274 quarter sections of rough grazing and range land which have corresponding ungulate ratings, 82.7% are class 3 and 4. Between ungulate classes 1 and 4 there are approximately 29,000 quarter sections of this agricultural land use which would present some conflict to ungulate summer habitat potential. (see table 32).

TABLE 32

P.L.U. AGRICULTURE (ROUGH GRAZING & RANGE) COMPARISON WITH UNGULATE CAPABILITY

K(Rough Grazing and Range Land) No. of Quarter Sections	%	Corresponding Ungulate Capability Ratings
894	2.9	1
2,379	7.6	2
16,757	53.6	3
9,087	29.1	4
2,133	6.8	5
24	0.1	6
0	0	7
31,274		

Comparison of P.L.U. Productive Woodland with Agriculture Capability

Within the study area approximately 24,500 quarter sections are categorized as productive woodland and approximately 23,000 have corresponding agricultural ratings. (see table 33). Only 619 or 2.7% are class 2 and 3 and this demonstrates that very little of the high agricultural capability land within the study area is in productive woodland. Approximately 20% of the productive woodland has an agricultural capability rating of 4 and suggests that some of this land is marginally suited for crops.

It is interesting to note that 1,586 quarters have an agricultural ratings of 0 which indicates organic soils. It is unlikely that productive woodlands would be found under these conditions and it appears that there is a slight error in classification, although it is impossible to know whether it is in the present land use or agriculture capability classification. There may also have been some problems in the classification of muskeg areas. Foresters would have been evaluating them in terms of tree growth, such as black spruce, while the pedologist would be looking for organic soils.

TABLE 33

P.L.U. WOODLAND (PRODUCTIVE)
COMPARISON WITH AGRICULTURE CAPABILITY

T(Productive Woodland). No. of Quarter Sections	%	Corresponding Agricultural Capability Ratings
0		1
205	.9	2
414	1.8	3
4,750	20.5	4
9,434	40.8	5
3.048	13.2	6
3,700	16.0	7
1,586	6.9	0
23,137		

Comparison of P.L.U. Productive Woodland with Forestry Capability

Almost 80% of the productive woodland is classed as forestry capability 4 and 5 and this tends to confirm the accuracy of this classification. Seven percent of the productive woodland is class 3 and the small figure reflects the lack of class 3 forest capability lands in Alberta. Eight percent of the productive woodland has a forestry capability rating of class 7 and this appears to be unusually high as this capability level represents severe limitations to the growth of commercial forests.

TABLE 34

P.L.U. WOODLAND (PRODUCTIVE)
COMPARISON WITH FORESTRY CAPABILITY

T(Productive Woodland) No. of Quarter Sections	%	Corresponding Forestry Capability Ratings
1,738	7.1	3
12,909	52.6	4
6,513	26.6	5
1,413	5.8	6
1,954	8.0	7
24,527		

Comparison of P.L.U. Productive Woodland with Ungulate Capability

The corresponding ungulate ratings in the productive woodland category are primarily classes 3 to 5. It is reasonable to assume that this would be the situation as this type of woodland offers suitable wildlife habitat.

TABLE 35

P.L.U. WOODLAND (PRODUCTIVE)
COMPARISON WITH UNGULATE CAPABILITY

T(Productive Woodland) No. of Quarter Sections	%	Corresponding Ungulate Capability Ratings
5	-	1
946	4.1	2
8,409	36.4	3
9,376	40.5	4
4,357	18.8	5
36	.2	6
0	.2	7
23,129		

Comparison of P.L.U. Non-Productive Woodland with Agriculture Capability

Most of the non-productive woodland is found on poorer quality agricultural lands with 85% being class 5 to 0. There is obviously little conflict between the land use and the agriculture capability.

TABLE 36

P.L.U. WOODLAND (NON-PRODUCTIVE) COMPARISON WITH AGRICULTURE CAPABILITY

U(Non-Productive Woodland) No. of Quarter Sections	%	Corresponding Agricultural Capability Ratings
0	-	1
49	.4	2
181	1.6	3
1,422	12.9	4
3,666	33.3	5
1,401	12.7	6
741	6.7	7
3,533	32.1	0
10,994		

Comparison of P.L.U. Non-Productive Woodland with Forestry Capability

The high percentage of non-productive woodland (30.4%) with the forestry capability rating 4 is rather unusual. This level of capability would normally indicate productive woodland. Possibly the explanation is that the non-productive woodland is cut-over or burned over land which still possesses its high forestry ratings.

TABLE 37

P.L.U. WOODLAND (NON-PRODUCTIVE)
COMPARISON WITH FORESTRY CAPABILITY

U(Non-Productive Woodland) No. of Quarter Sections	%	Corresponding Forestry Capability Ratings
285	2.6	3
3,345	30.4	4
2,444	22.2	5
1,302	11.8	6
3,620	32.9	7
10,996		

Comparison of P.L.U. Non-Productive Woodland with Ungulate Capability

There appears to be little conflict between non-productive woodland and ungulate capability. Approximately 96% of this woodland category has ungulate capability classes of 3 to 5 which indicates a logical relationship.

TABLE 38

P.L.U. WOODLAND (NON-PRODUCTIVE)
COMPARISON WITH UNGULATE CAPABILITY

U(Non-Productive Woodland) No. of Quarter Sections	%	Corresponding Ungulate Capability Ratings
32	.3	1
329	3.2	2
3,470	24.4	3
3,800	37.5	4
3,493	34.5	5
14	.1	6
0	-	7
10,138		

Comparison of P.L.U. Wetland with Agriculture Capability

Approximately 94% of the present land use category wetland has corresponding agricultural capability ratings of class 5 to 0 with 58% being class 0. These figures especially the 58% in class 0 tend to confirm the accuracy of the agricultural capability classification.

TABLE 39

P.L.U. WETLAND
COMPARISON WITH AGRICULTURE CAPABILITY

M(Swamp, Marsh or Bog) No. of Quarter Sections	%	Corresponding Agricultural Capability Ratings
1	.09	1
6	.6	2
16	1.5	3
44	4.1	4
154	14.5	5
146	13.7	6
79	7.4	7
616	58.0	0
Total 1,062		

Comparison of P.L.U. Wetland with Forestry Capability

Approximately 84% of the quarter sections which have been classed as wetland have a corresponding forestry capability rating of class 7. These figures tend to confirm the accuracy of the forestry capability classification.

TABLE 40

P.L.U. WETLAND
COMPARISON WITH FORESTRY CAPABILITY

M(Swamp, Marsh or Bog) No. of Quarter Sections	%	Corresponding Forestry Capability Ratings
0	0	3
34	4.5	4
48	6.3	5
39	5.1	6
640	84.1	7
Total 761		

Comparison of P.L.U. Wetland with Ungulate Capability

Approximately 70% of the quarter sections in the wetland category have corresponding ungulate ratings of class 4 and 5. These ratings appear resonable in that the present land use wetland category would offer some potential for ungulate habitat especially for moose. This points out the importance of indicator species in the ungulate classification as habitat requirements are certainly different for moose, elk, deer, sheep, etc.

TABLE 41

P.L.U. WETLAND
COMPARISON WITH UNGULATE CAPABILITY

M(Swamp, Marsh or Bog) No. of Quarter Sections	%	Corresponding Ungulate Capability Ratings
18	1.7	1
9	0.8	2
131	12.1	3
251	23.2	4
521	48.1	5
153	14.1	6
0	0	7
Total 1,083		

Comparison of P.L.U. Wetland with Waterfowl Capability

The figures in table 42 indicate that 61% of the wetland category has a waterfowl capability rating of class 6. This appears to be reasonable as waterfowl do much better in areas which contain both small water bodies and well drained agricultural lands. Muskeg areas have little potential for any renewable resource use.

TABLE 42

P.L.U. WETLAND
COMPARISON WITH WATERFOWL CAPABILITY

M(Swamp, Marsh or Bog) No. of Quarter Sections	%	Corresponding Waterfowl Capability Ratings
20	1.7	1
24	2.0	2
192	16.2	3
55	4.6	4
119	10.0	5
728	61.3	6
50	4.2	7
Total 1,188		

Obviously this preliminary evaluation does not provide conclusive evidence on the accuracy of the capability classifications. Detailed analysis of the statistics generated would be required to produce decisive results, and the accuracy of the present land use classifications would have to be verified. However, if it is assumed that the present land use categories are accurate, then it can be said that the capability classifications indicate a degree of confidence. Conversely it could be said that the present land use often reflects the renewable resource capabilities of the land. However, it must be remembered that natural site capability can be modified by drainage, vegetative cover change, etc., and this is often done in contiguous units even if the lands are of poor quality. Isolated and small areas of high agricultural capability, for instance, cannot usually be cultivated economically.

One of the objectives of this section of the thesis has been to attempt to utilize the Land Use Planning Data Bank for purposes other than land capability analysis and resource allocation. It was hoped that the data bank and computer system could be used to generate statistics on the relationships between the various Canada Land Inventory classifications. However, the system was structured in such a fashion that it became extremely difficult and expensive to generate even elementary data. As a result of these limitations, it was not possible to conduct further research to explain some of the incongruities identified in tables 23 to 42. Nevertheless, it has been considered important to include them in the thesis, even though they are incomplete, as some definite relationships have been identified.

3. Use of Background Data in Establishing Reliability of Capability Classifications

There are several sources of background material from other surveys and classifications that can be used in establishing the reliability of the C.L.I. classifications. In some cases, the C.L.I. may have been partially based on this information while in others it can be used only to verify the quality of the classification.

(a) Farm Land Assessment Information

All agricultural lands in Alberta are assessed according to specific guidelines which provide information on the present land use and capability of individual quarter sections. This information can be compared with present land use and agriculture capability data provided on a quarter section basis through the Land Use Planning Data Bank which has been established by Alberta Municipal Affairs. This data bank has converted C.L.I. ratings to a quarter section level.

Soils

Soils information which can be obtained from the assessment records includes soil group - black, grey wooded, dark brown, peat, degraded black etc., sub-soil - solod, solonetz, gravel, alluvium, etc., texture - clay, silt, loam, silty clay loam, sandy loam, etc.; and degree of stoniness - no stones, occasional stones, excessively stony, etc. The degree of limiting factors inherent in this information should be reflected in the soil capability ratings for specific quarter sections. To date, no testing has been done on the comparativeness of the two.

Present Land Use

Assessment records also contain information on number of arable acres, improved pasture acres, unimproved pasture acres, hayland acres, bush or treed acres by density and miscellaneous acres which include waste lands, buildings, roads and areas exempt from taxation. Through the use of the data bank it should be possible to correlate this information with the present land use classification to see if the two systems are comparable. Farmland assessments are conducted in the field so the ratings should be accurate. If not, the farmer would certainly launch an appeal. However, studies in Prince Edward Island have indicated inaccurate assessments of farm woodlands and marshlands. They were underestimated for census records and overestimated for municipal assessments. If present land use from the C.L.I. and farmland assessment are compared then the date of photography of the former should be as close to the date of assessment as possible.

Assessed Land Value

It is possible that land value figures from the assessment records could be compared with soil capability ratings. Land assessment figures should be greater on higher capability lands. However, considerable testing would be required to establish if there is a correlation.

A small study was conducted by the Planning Services Division of Municipal Affairs in 1974 to test this hypothesis. The assessed values of agricultural land in the delivery area of the High Prairie's grain elevators were investigated. Values ranged from less than $500.00 to over $4,000.00 per quarter section. It was found that land values tended to increase as distance to High Prairie decreased and was not specifically related to capability. However, some correlation was found between land assessment and capability. Much of the land around High Prairie has an agriculture capability rating of class 2 and assessed values ranged from $2,000.00 to $4,000.00 per quarter section. Lower capability lands received assessments in the $500.00 range.

Final Percentage

Probably the most important piece of information that can be obtained from assessment records is that of final percentage. The final percentage denotes the percentage productivity potential of all arable land in a particular quarter section as compared to an ideal soil which has a rating of 100%, (e.g., of 100% rating - black soil zones in Red Deer area). The final percentage is determined by the following method:

1. the total number of arable acres and their total value is determined.

2. the average value of land per acre for the arable land is calculated.

3. the value of a 100% soil has been established at $40.00 per acre. The final percentage is calculated by dividing the average value of the land by $40.00 and multiplying by 100.

Final percentage figures have been divided into eight categories to correspond to the Storie Rating System which is used in Alberta Soil Survey Reports.

TABLE 43

RELATIONSHIP BETWEEN SOIL RATINGS & FINAL PERCENTAGE

(as established by Soil Surveys)

Soil Utilization Ratings	Class	Percent Rating
8	Very good to arable	78 - 100
7	Good to very good arable	58 - 78
6	Fairly good to good arable	41 - 58.
5	Fair to fairly good arable	28 - 41
4	Poor to fair arable	16 - 28
3	Good to very good pasture	9 - 16
2	Fair to good pasture	4 - 9
1	Poor to fair pasture	0 - 4

Source: Alberta, Department of Municipal Affairs, Farm Land Assessment Manual, Section 3, 1969.

The eight classes of the Soil Surveys have also been correlated to the seven classes of the C.L.I. agriculture capability classification, so it should be possible to test the relationship between capability classes and final percentage.

(b) Soil Survey Reports

Another method of evaluating the agriculture capability classification is through the use of soil surveys. Much of the agriculture classification was indeed based on these surveys. "This classification (soil capability) provides for an interpretive grouping, based on soil limitations of areas for agricultural use."[107] Soil survey information on a quarter section basis was incorporated into the Land Use Planning Data Bank of Alberta Municipal Affairs for the Hinton-Yellowhead region, but the agriculture capability classification was never tested against it.

A Soil Productivity map, which is based on such factors as type of soil profile, soil texture, degree of stoniness, topography, etc., is included in most of the soil survey reports.

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[107] Alberta, Research Council Soil Survey of the Chip Lake Area, Alberta Soil Survey Report, s-71-28, 1971, p. 63.

> Soil rating is an interpretation of the soil morphological features as they may affect plant growth and agricultural use. On the basis of this numerical rating, the soils are tentatively grouped according to their suitability for grain production.[108]

It is this rating system which was used to calculate final percentage figures that is now used as a comparison with the agriculture capability classification. Soil productivity maps which contained eight classes were compared to maps of the same areas for the C.L.I. seven-class classification in order to establish the following relationships:

TABLE 44

ALBERTA SOIL SURVEY: SOIL RATING SCHEDULE (1965)

		Pasture				Cultivation		
Soil Survey Rating	1	2	3	4	5	6	7	8
C.L.I. Class Equivalent	7 0(organic)	6	5	4		3	2	1
Description of Value of Agriculture	poor to fair	fair to good	good to very good	poor to fair	fair	fairly good to good	good to very good	very good to excellent

Source: Alberta Soil Survey, cited in Alberta Municipal Affairs Lesser Slave Lake Regional Plan, Rural Land Use Study, Section III, Allocation of Land According to Renewable Resource Potential, 1974.

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[108] Ibid., p. 62.

(c) Grain Elevator Permits

Another method of evaluting the reliability of the agriculture capability classification would be to record quarter-section yield figures as indicated in grain elevator permit booklets. Over a time span these booklets would give an indication of the ability of particular quarter sections to produce grains. It then might be possible to relate these yield figures to capability class. Little research in this area has been conducted however, it has been indicated that an attempt is being made to relate the two in Manitoba. Some of this data may also be available from the research conducted for the rail line abandonment studies of the Federal Department of Agriculture.

(d) Forest Cover Inventory

Forest cover information in Alberta is available at various levels of detail and scale. Most forest cover maps show tree type, density and height and it is possible to calculate volume and growth figures. The forestry capability ratings with their associated productivity ranges could then be evaluated against this information. The major problem would be that the C.L.I. forestry maps show capability and do not reflect the present forest cover of an area. However, in mature timber areas of the Province, it may be possible to establish a relationship.

In this chapter a number of research studies, in which attempts has been made to establish the reliability of individual classifications have been reviewed. In addition the author has undertaken some research to determine relationships between various classifications. A number of external factors which could be used to establish the reliability of the classifications have also been discussed.

Diverse opinions exist as to the reliability of the classifications; however, most of the research indicates that there is a high degree of accuracy at the regional level of analysis. Accuracy at the micro or management level is questionable but varies between classifications.

In the next chapter some of the uses made of individual classifications will be evaluated.

CHAPTER VI

UTILIZATION OF INDIVIDUAL CANADA LAND INVENTORY CLASSIFICATIONS

In this chapter some of the uses made of individual classifications will be evaluated. In a later chapter the author will examine those studies which combine a number of classifications in the evaluation of resources and the establishment of priorities.

Canada Land Inventory classifications have been available in published form for up to 10 years and have received extensive exposure across the country. The information has been primarily utilized by government agencies and in some cases adopted through legislation; however, the public has made use of the classifications, especially the soil capability classification for agriculture.

Virtually hundreds of published resource documents have included some reference to the Canada Land Inventory, and a selection of these will be discussed in this chapter. Most of the examples are from Alberta but a few are from other provinces and in some cases the system has even been adopted outside Canada.

1. Present Land Use

Maps of the present land use classification were never published at the 1:250,000 scale as with the other capability classifications (with the exception of sport-fish). As a result there has been less opportunity to utilize the classification. It is unfortunate that the 1:250,000 map sheets were not published as they would have been valuable for comparison purposes with the capability maps. 1:50,000 ozalid map sheets are available from the original mylars for Alberta from the Technical Division of Alberta Energy and Natural Resources but their availability is not advertised. Some of the original map sheets and ozalids are also available in the map and air photo library of the University of Alberta.

The classification was one of the first to be completed and the maps are now about 10 years old. Unlike the capability classifications this classification will lose its usefulness over time. However, it can be argued that this statement could apply to the capability classifications, if further research indicates that requirements for production are different from those used to determine the ratings. With reference to the present land use classification it has been indicated that

> the usefulness of this kind of information depends largely upon its detail and vintage. Outdated 'present' land use information is as exciting and useful as last week's newspaper.[109]

Although this statement may be partially valid, the classification has provided an important base for many land use studies. The maps can be used to show land use changes, an important component of any land use plan. Where required, they can be updated with air photographs and assessment and disposition records.

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[109] Anon Potential Uses of Canada Land Inventory Information in Manitoba, Part II, 1969, p. 15.

(a) Utilization in Alberta

In the Peers-Whitecourt Land Use Study conducted by the Provincial Planning Branch of Alberta Municipal Affairs in 1970, the classification was used to formulate estimates of the extent and location of land in various categories of use. The classification was utilized to indicate areas where present use was not compatible with capability classifications and where land was not being used to the full extent of its capability. Land uses in the study area were calculated on a township basis and the following totals were obtained for the study area:

TABLE 45

PEERS-WHITECOURT LAND USE STUDY - PRESENT LAND USE

Legend	Area-Acres	Percentage
Urban areas	995	.32
Gravel Pits	60	.02
Outdoor Recreation	15	-
Cropland	17,925	5.79
Improved Pasture & Forage Crops	7,135	2.30
Productive Woodland	144,145	46.53
Non-Productive Woodland	110,425	35.65
Swamps	5,425	1.75
Water Surface	9,380	3.03

Source: Alberta Municipal Affairs, Peers-Whitecourt Land Use Study, 1970.

Present land use maps were also used by the Planning Services Division (formerly Provincial Planning Branch) of Alberta Municipal Affairs in developing a generalized land use map for the Beaver River Land Use Study in Northeastern Alberta.

Although not specifically indicated it appears that present land use maps were used by other agencies in the preparation of land use studies. The present land use map in the report Physical Environment Inventory prepared by the Red Deer Regional Planning Commission in 1972-73 is probably based on the C.L.I. present land use classification. The map is divided into six categories: cropland, pasture and range land, forest and wood land, alpine tundra, unproductive land and water.

(b) Utilization in Ontario

It also appears that the Regional Development Branch of the Ontario Department of Treasury and Economics used the present land use classification in the preparation of a generalized land use map in the report Design for Development: Midwestern Ontario Region, Phase I: Analysis, published in 1970.

Although L. G. Reeds was critical of the present land use classification in his paper The Land Use Survey of the Niagara Peninsula - A Critical Review, he did point out some of the positive benefits of the maps. "A mosaic of the Niagara land use sheets presents a picture of geographic patterns which cannot be seen by any other means, unless the landscape is seen with binoculars from a hovering, high-flying plane."[110] More specifically Reeds indicates "The great contrast between the specialized agricultural development of the lowland north of the escarpment and the patterns of use associated with mixed farming and dairying in the dip-slope plain is clear."[111]

Relatively few examples on the use of this classification can be found. However, this does not mean that it is not being used. It is employed by many planning agencies as preliminary inputs for various studies but is never published.

It is unlikely that the present land use classification will be updated using the same techniques as in the original one. Any future classification will undoubtedly take advantage of progress in remote sensing. Remote sensing which measures reflected or emitted radiation in the visible and infrared spectral regions offers potential for soil, crop and forest classification.

2. Soil Capability Classification for Agriculture

The soil capability classification for agriculture has received more use than any of the other classifications. The loss of agricultural land to urban and industrial uses has been of major concern to Canadians during the past few years. As a result the soil capability classification has been used both by government agencies and the public to document the loss of prime agricultural lands and to indicate lands that should be maintained for agriculture.

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[110] L. G. Reeds, The Land Use Survey of the Niagara Peninsula - A Critical Review, Geographical Bulletin, 7(324), 1965, p. 206.

[111] *Ibid.*, p. 207.

(a) Utilization in Atlantic Canada

The Province of Prince Edward Island has utilized the agriculture capability classification to determine the future use of private lands purchased by the Province. The report Land Use Programs in Canada,Prince Edward Island published by the Lands Directorate of Environment Canada in 1974 indicates "If the land is of a low agricultural capability (C.L.I. agriculture capability Class 4 or lower) or of a high capability rating (Class 3 or better) for a use or uses other than agriculture, these lands are held by the corporation for long-term administration and management in conjunction with provincial government department agencies." [112]

In the Mactaquac Regional Development Plan - Summary Report prepared for New Brunswick class 2 and 3 agricultural lands are rated as farmland. Marginal and poor farmland are classed 4-7. Cleared land in the study area was compared to the soil capability ratings and the following results were obtained.

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[112] V. Cranmer, Land Use Programs in Canada, Prince Edward Island, Lands Directorate, Environment Canada, 1974, p. 19.

TABLE 46

RELATIONSHIP BETWEEN SOIL CAPABILITY AND CLEARED LAND MACTAQUAC REGION - NEW BRUNSWICK

Class	% Cleared
1	-
2	1.5
3	23.2
4	55.8
5	17.5
6	.5
7	1.5

Source: The New Brunswick ARDA Committee, H. C. Acres & Company Ltd., Mactaquac Regional Development Plan Summery Report, 1965.

In 1970 the Department of Regional Economic Expansion prepared a report entitled Soil Capability Analysis for Agriculture in Nova Scotia. In the study, present land use was compared to soil capability, and the categories of agricultural land were blocked out as multi-crop agricultural blocks and limited use agricultural blocks. Included in the criteria for the first category was that it have not less than 1,000 acres of cleared and arable land being Class 2. The limited use agricultural blocks had to contain Class 3 land with minimum inclusions of Class 4 permitted, and contain a minimum of 500 acres of cleared land if the blocks were separated from other agricultural blocks by more than three miles. Lower class lands were considered non-agricultural. Fifteen multi-crop blocks and fifty-four limited use blocks were outlined for the Province.

In table 47 the class and acreage figures for the two types of blocks are summarized.

TABLE 47

CLEARED AND TOTAL ACREAGE OF SOILS IN MULTI-CROP AND LIMITED USE BLOCKS - NOVA SCOTIA

	Cleared	Total	Cleared as % of Total
		CLASS 2	
Multi-Crop Blocks	124,608	281,370	44
Limited Use Blocks	23,945	81,703	29
Total All Blocks	148,553	363,073	41
		CLASS 3	
Multi-Crop Blocks	169,511	441,859	38
Limited Use Blocks	219,768	1,427,870	15
Total All Blocks	389,279	1,869,729	21

TABLE 47...continued

	Class 4		
	Cleared	Total	Cleared as % of Total
Multi-Crop Blocks	27,951	63,489	44
Limited Use Blocks	22,236	139,264	16
Total All Blocks	50,187	202,753	25
		MISCELLANEOUS	
Multi-Crop Blocks	19,427	143,583	13
Limited Use Blocks	19,662	262,139	7
Total All Blocks	39,089	405,722	9

Non-Agricultural land use

Category contains 10,216,000 acres

Source: Soil Capability Analysis for Agriculture in Nova Scotia, Canada Land Inventory, Department of Regional Economic Expansion, 1970.

In 1974, the Lands Directorate of Environment Canada conducted a study of landowners and land use in the Musquodoboit Valley of Nova Scotia. The Canada Land Inventory was used to determine the physical capability of the watershed, and the study contains one of the few examples of the use of soil capability limitations.

The study recommends that cleared lands with agricultural capability ratings of Class 2, 3 and 4 should be maintained for agricultural production.

TABLE 48

SOIL CAPABILITY FOR AGRICULTURE IN MUSQUODOBOIT VALLEY

		Acreage	
C.L.I. Class	Limitation	Sub-totals	Total
2	Inundation by streams or lakes (I)		3,772
3	Undesirable soil structure and/or low permeability (D)	58,061	
	Inundation by streams or lakes (I)	324	
	Moisture Limitation (M)	756	
	Stoniness (P)	1,080	
	Topography (T)	9,098	
	Excess Water (W)	402	69,721
4	Inundation (I)	18	
	Moisture (M)	198	
	Stoniness (P)	108	
	Consolidated Bedrock (R)	5,364	
	Consolidated Bedrock and/or Stoniness (RP)	11,577	
	Excess Water (W)	1,402	18,667
5	Excess Water (W)		3,402
7	Stoniness (P)	67,496	
	Consolidated Bedrock (R)	2,616	70,085
0	Organic Soils		6,[illegible]31
	Water Excess		4,194
Total Watershed Acreage			175,872

Source: Lands Directorate, Environment Canada, Landowners and Land Use in the Musquodoboit Valley, Nova Scotia, 1974.

(b) Utilization in Ontario

Reference is made to the soil capability classification in Phase I: Analysis of the Design for Development: Midwestern Ontario Region published by the Ontario Department of Treasury and Economics in 1970. The report indicates that the region contains 24% of Ontario's class 1 soils, 10% of Class 2 and 9% of Class 3. A detailed breakdown showing soil capabilities 1, 2 and 3 with associated acreages and percentages on a county and township basis is provided in the report. Areas of the region where existing agricultural use falls below the capability of the land is illustrated in another table. From the figures provided it is possible to compare farmland acreages from the 1966 Census of Canada with agricultural potential for Classes 1, 2 and 3 on a county and township basis.

Within the Midwestern Ontario Region there is a total of 712,046 hectares (1,759,503 acres) of improved farmland as of the 1966 Canada Census. Class 1-3 soil capability lands total 784,236 hectares (1,937,890 acres). Hence, there are 72,191 hectares (178,387 acres) of undeveloped Class 1-3 land. This figure is probably even higher since some of the improved land reported in the census is probably in areas with a capability rating of less than Class 3.

TABLE 49

RELATIONSHIP OF IMPROVED FARMLAND, 1966, TO SOIL CAPABILITY
MIDWESTERN REGION ONTARIO

County	Improved Farmland 1966(ac.)	% of County	Class 1 Acres	% of County	Class 2 Acres	% of County	Class 3 Acres	% of County	Class 1 - 3 Acres	% of County
Huron	620,472	75	421,175	51	202,750	24	95,515	11	719,440	86
Perth	456,893	85	314,850	59	124,390	23	50,425	09	489,725	91
Waterloo	225,536	75	89,040	29	75,980	25	45,520	15	210,540	69
Wellington	456,602	70	342,355	53	74,275	11	101,555	16	518,185	80

Total Improved Farmland = 1,759,503 acres

Total Class 1-3 land = 1,937,890 acres

Source: Ontario Department of Treasury and Economics,
Design for Development Midwestern Ontario Region Phase 1 ,1970

In 1972 the Centre for Resource Development of the University of Guelph prepared a report entitled Planning for Agriculture in Southern Ontario. This report contains numerous references to the soil capability classification for agriculture as it pertains to agricultural lands in southern Ontario. The performance indices for the various soil capability classes as developed by Hoffman, Anderson, Noble and the Committee on Farm Assessment Indices are discussed in detail.

A section of the report describes the conflict that exists between agricultural potential and quarrying for sand and gravel. Significant conflicts between soil capability Classes 1 and 2 and quarrying is limited to the fringe area between southwestern and southcentral Ontario and primarily in the counties of Waterloo and Brant. Considerable conflict in the Toronto-Centred Region was also identified.

The report also identifies the possible loss of high capability agricultural lands due to urban expansion in the metropolitan areas in southern Ontario. (see table 50). It is estimated that 60,136 hectares (148,600 acres) of Class 1 and 2 soils will be lost to urban expansion between 1971 and 1991 and this represents a loss of 1.5% of the total acreage of these soils.

Policy guidelines in the report recommend that Class 1 and 2 lands should be reserved for agriculture where feasible and Class 3, 4 and 5 lands should be reserved for extensive farming such as livestock raising.

TABLE 50

ESTIMATED LOSSES OF CLASS 1 AND 2 SOILS
DUE TO EXPANDING URBAN INFLUENCE
SELECTED URBAN MUNICIPALITIES OF SOUTHERN ONTARIO, 1971-1991

Economic Region	Urban Municipality	Increase in Urban Area (000 acres)	Class 1 and 2 Soils Estimated Loss (000 acres)
St. Clair	Windsor	10.90	9.6
	Chatham	3.29	2.9
	Sarnia	4.76	1.5
Lake Erie	London	11.04	8.8
Niagara	Hamilton	25.19	13.7
	Brantford	3.04	1.8
	Niagara Falls	4.40	2.1
	St. Catharines	8.22	4.3
	Welland	4.40	2.2
Midwestern Ontario	Kitchener - Waterloo	12.15	6.2
	Guelph	3.37	1.6
Central Ontario	Toronto	102.97	70.4
	Brampton	10.27	7.4
	Oshawa	13.98	7.6
Lake Ontario	Belleville	2.09	0.7
	Peterborough	2.61	1.3
Eastern Ontario	Ottawa	19.58	5.6
	Kingston	4.15	0.9
TOTAL		246.50	148.6

Source: Centre for Resources Development, University of Guelph, *Planning for Agriculture in Southern Ontario*, 1972

A policy paper, Economic Development, prepared by the Regional Municipality of Waterloo in Ontario in 1974, stressed the goal of maintaining good agricultural land. Sixty-seven percent of the land in the region was rated as Class 1 and 2 and an additional 18% as Class 3. Two of the recommendations in the 'directions for policy' related to the soil capability for agriculture classification. "Based on soil capabilities primarily, rural areas within the region should be zoned for agricultural uses as opposed to other rural uses...(d) That lands zoned agricultural should in the first instance encompass all Class 1 and II land, and over-riding public need will be the only acceptable criterion for rezoning." [113]

In 1974, the Ontario Ministry of Natural Resources prepared a report entitled Background Information and Approach to Policy, Northwestern Ontario, Strategic Land Use Plan. Agricultural capability has been generalized into three categories, High Class 1-3, Moderate Class 4 and 5, and Low Class 6 and 7. Only two areas around (1) Thunder Bay and (2) Fort Frances, Kenora, Dryden, were classified. The study recommends that non-farm residential developments not be located on Classes 1-3 agricultural land. In addition, all Class 1 to 3 lands, and possibly Class 4 should be reserved for agriculture.

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[113] Regional Municipality of Waterloo, Policy Paper No. 3, Economic Development, for discussion purposes leading to the Regional Official Policies Plan, Department of Planning and Development, 1974, p. 34.

Another study in Ontario, Countryside Planning, A Pilot Study of Huron County, published by the Ministry of Housing in 1976 has utilized the soil capability classification for agriculture. The study provides a detailed description of how boundaries for land allocated to agriculture would be determined.

> a) In a county/region, begin with the largest area of highest agricultural capability in which more than 50% of Classes 1 to 3 of tillable land in current use for food production or farm operations.
>
> b) Continue adding to that area all contiguous land units of capability equal to, or better than, Class 4 (use a weighted average in complex capability areas) plus organic areas.
>
> c) At least 50% of the cleared and tillable land of agricultural capability Class 1, 2 and 3 must be in current farm use...Otherwise, the area does not count towards the delineation of the agriculture area....
>
> d) Where areas of poor agricultural capability (lower than 4) are encountered, include them in agriculture if they are less than two miles in width (unless they form part of a linear or corridor landscape system with high recreation capability or environmental importance).
>
> e) Smooth the edge of the agriculture area...and thus include within the perspective area those minor intrusions from the adjacent perspective regardless of capability....
>
> f) In areas of heterogeneous capability for farming, with small landscape units (C.L.I.), if 50% or more of the Class 4 land has a topographic limitation (T), the Class 4 land would be considered as Class 6 in calculating the average capability and delineating it for perspective purposes.

g) Areas with complex landscape units with a combined rating should have a weighted average calculated. Include these as agriculture if the weighted average is 4 or better and if the better soils do not have topographic limitations.[114]

In general terms, this includes all areas which have soil capability ratings of Class 1 to 4.

The study indicates that land areas within the designated agricultural zones will have priorities for other uses, and once these priorities are established, the dominant priority or other criteria will have to be utilized to resolve the conflict.

The policy section of the report indicates that "Large areas (approximately one square mile) of poor agricultural land (Classes 4, 5, 6 and 7) shall be considered as resources for the location of uses that are not suitable to a farming designation."[115] The section also indicates that country residential development in farming areas will be restricted to clusters in Classes 5, 6 and 7 lands with a buffer of at least 610 metres (2,000 feet) between Classes 1 to 3.

In the urban zones low density housing would not be permitted on Classes 1 and 2 lands adjacent to communities as they would be reserved for farming.

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[114] James F. Maclaren Ltd., Environmental Consultants, Countryside Planning, A Pilot Study of Huron County, prepared for County of Huron and Ontario Ministry of Housing, 1976, pp. 14-15.

[115] Ibid., p. 91.

> Farming areas shall be given preference on Classes 1 and 2 soils (C.L.I.) similar to consideration given to special farming. These farming areas are intended to be functional parts of the urban perspective area, not simply holding zones. Farming shall thus be given prime sites just as shopping centres are given prime sites for their location.[116]

The report concludes that the dominant perspective for the County should be agriculture since 89% of the land base is rated as agricultural capability class 1 and 2.

The use of the soil capability for agriculture classification in this study is quite intriguing. The degree of land use designation based on capability classes suggests that the consultants placed considerable reliance on the classification. Some of their recommendations such as designating farm lands in urban areas will certainly be challenged by developers and politicians, and it will be interesting to see if the County of Huron adopts the recommendations.

In 1977 the Ontario Ministry of Agriculture and Food prepared a Green Paper on Planning for Agriculture: Food Land Guidelines. "In the document entitled 'A Strategy for Ontario Farmland' released in April 1976, the Government of Ontario declared its commitment to maintain a permanent, secure and economically viable agricultural industry for Ontario, not only as a producer of food, but as an important component of our economic base, a source of employment and as the basis of the rural community and rural way of life." [117]

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[116] Ibid., p. 143 .

The Food Land Guidelines were intended to provide a methodology by which agricultural considerations could be incorporated into municipal and regional plans through subdivision policies and zoning bylaws.

In order to implement these guidelines it was first necessary to identify those lands with agricultural potential, and four categories of potential were outlined.

> All lands which have a high capability for the production of specialty crops due to special soils or climate.
>
> All lands where soil classes 1, 2, 3 and 4 predominate as defined in the Canada Land Inventory.
>
> Additional areas where farms exhibit characteristics of on-going viable agriculture.
>
> Additional areas where local market conditions ensure agricultural viability where it might not exist otherwise. [118]

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[117] Ontario, Ministry of Agriculture and Food, Green Paper on Planning for Agriculture: Food Land Guidelines, 1977, p. 2.

[118] Ibid., p. 2.

In establishing agricultural priorities based on these four categories, it was indicated that high value specialty crops should be given a high priority as the areas where these crops could be grown were limited in extent. Also to be given high priority were those areas which had a high C.L.I. rating for agriculture and were also suited to specialty crops.

In the policy paper competing demands for land are recognized but a definitive solution is not provided. "The land may have the capability for several different uses, or a variety of land use may be competing for land with a single, overriding capability...The resolution of these conflicting demands will vary according to the types of land use to be accommodated, the amount and nature of the land resource available, and the future growth pressures expected." [119]

The guidelines for the designation of agricultural lands indicate that "the highest priority agricultural lands must be separated out into large, contiguous blocks and given greater protection for agriculture than is generally provided." [120] This procedure was recommended in Countryside Planning, A Pilot Study of Huron County, and it appears that this 1976 study had considerable influence in the preparation of this Green Paper.

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[119] Ibid., p. 4.

[120] Ibid., p. 5.

(c) Utilization in Western Canada (exclusive of Alberta)

The Manitoba Department of Mines and Natural Resources in 1970 prepared a Land Use Study for the South Side Riding Mountain Area. In this study individual quarter sections were rated using the soil capability classification for agriculture. The quarter sections were further rated according to their capability for agricultural crops and for grazing.

The proposed land use guidelines for the study indicated that land classed from 1 to 3 should be utilized for grain, and land units with combinations of 3, 4 and 5 be utilized for grain, forage and livestock production.

> A viable unit of this combination would require a larger acreage than a straight grain enterprise. The size of the unit would depend on the acreage of the various land classes within the unit, i.e., the larger the percentage of Class 4 and 5 land, the larger the overall acreage of the unit.[121]

The study further indicates that all lands with capability of 3 or better should be used for arable agriculture, Class 4 lands under bush cover should be cleared and primarily used for forage and Class 5 lands used only for improved or unimproved grazing depending upon the existing land use.

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[121] Manitoba Department of Mines and Natural Resources, G. C. Jenkins, Land Use Study of the South Side Riding Mountain Area, ARDA Project 7038, 1970, p. 49.

A series of regional economic studies prepared by the Federal Department of Agriculture over the past several years have focused on providing information on socio-economic activity and on grain farms and delivery points in areas of the prairies where rail lines had been considered for abandonment. Soil capability for agriculture maps were utilized to determine the agricultural capability of those areas where lines would be abandoned and delivery points closed.

Studies in the series cover the Riverhurst, Rockglen, Weyburn and Easton-Elrose regions of Saskatchewan, the Boissevain, Killarney and Brandon-Neepawa regions of Manitoba, and the Camrose-Vegreville, Cardston, Bassano, Brooks and Stettler regions of Alberta.

In a study of Water Resources and Related Land Uses in the Strait of Georgia - Puget Sound Basin Area of British Columbia and Washington State in 1974, the soil capability for agriculture classification was used to designate lands suited for agriculture. This study prepared by Environment Canada indicated that Class 1 and 2 lands were limited to the Lower Fraser Valley and coastal lowlands and could support intensive cultivation. Class 3 and 4 were also suited to cultivation and could support a reduced range of crops. Class 5-7 lands were indicated as being able to support only permanent pasture, wildlife and woodland.

One of the best examples of the use of the soil capability classification at the provincial level is from British Columbia. In 1973, the government legislated the British Columbia Land Commission Act to protect agricultural lands. Prior to 1973, 6,070 hectares (15,000 acres) of prime agricultural land was annually being lost to urban sprawl. Less than 1% of the land area of British Columbia is Class 1 agricultural capability.

Agricultural land reserves based on agricultural capability Classes 1 to 4 have been established by the Commission.

> The Land Commission is empowered to preserve agricultural land for farm use by means of the establishment of protective zones. These zones are shown on maps commonly known as Agricultural Land Reserve Plans. The Commission also has the authority to purchase agricultural land and to hold, manage, lease or sell purchased land at its discretion.[122]

The agricultural land reserves are a form of zoning which protects agricultural lands from encroachment of non-agricultural uses.

The establishment of Agricultural Land Reserves, based primarily on soil capability Classes 1 to 4, is the most powerful use of such information on a provincial scale in Canada.

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[122] British Columbia Government, Land Commission, Keeping the Options Open, 1975, p. 8.

(d) Utilization by the Federal Government

In 1976, the Lands Directorate of Environment Canada prepared a preliminary report on Land Capability for Agriculture. The study points out that one-half of one-percent of Canada's total land area is Class 1 soil capability and 5% is rated Class 1 to 3. Eighty-eight percent of the country's total land area has no agricultural capability. (see table 51)

(e) Utilization in Alberta

In 1976, the Lands Directorate of Environment Canada prepared a Soil Capability for Agriculture map of Alberta at a scale of 1:1,000,000. This generalized map was produced by combining information from the published 1:250,000 map sheets and presents an ideal perspective of the province's agricultural potential. The map provides a breakdown of classes by acreage and associated subclass limitations.

The loss of agricultural land was documented in a newspaper article in 1974 by Dr. J. A. Toogood, of the Alberta Institute of Pedology, University of Alberta.

TABLE 51

C.L.I. CLASSIFICATION OF SOIL CAPABILITY FOR AGRICULTURE

	CLASS							
Province	1	2	3	4	5	6	7	0 (organic)
Newfoundland	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Prince Edward Island	0	645,791	349,700	122,998	187,877	0	68,378	16,489
Nova Scotia	0	410,821	2,427,617	1,048,319	203,080	35,387	8,674,795	287,189
New Brunswick	0	397,312	2,846,772	5,023,626	4,202,813	28,538	4,544,329	327,486
Quebec	48,266	2,247,767	3,165,413	6,388,113	4,100,406	26,368	51,310,434	3,774,044
Ontario	5,329,320	5,480,036	7,189,177	6,488,284	4,733,138	2,817,523	27,727,064	6,333,899
Manitoba	401,552	6,252,181	6,030,356	5,908,745	5,529,607	5,152,752	2,555,549	10,990,338
Saskatchewan	2,470,292	14,512,689	23,276,642	9,347,635	21,059,390	7,215,335	87,911	4,387,862
Alberta	1,943,550	9,485,953	15,097,711	22,943,417	27,430,124	9,720,922	10,357,377	14,807,901
British Columbia	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Canada	10,192,980	39,432,550	60,383,388	57,271,137	67,446,435	24,996,825	105,325,837	40,925,208

N/A - Not Available

It is estimated that there are approximately 6,000,000 acres of Class 1 to 3 soils in British Columbia

Class 1 and 2 land is not found in Newfoundland

About 1/2 of Canada's Class 1 land is found In Ontario

The three Prairie Provinces contain 67% of Canada's potential cropland (Class 1 to 3)

Over 95% of Quebec's land area is incapable of supporting agriculture

Source: Lands Directorate, Environment Canada, Land Capability for Agriculture, Canada Land Inventory A Preliminary Report, 1974.

> In the last seven years the growth of Edmonton has resulted in the loss of 19,438 acres from our food producing areas around the city. Of this total 10,120 acres, or 52% was choice agricultural land rated as Class 1 in the Canada Land Inventory. Another 5,280 acres, or 30% was rated as Class 2, and 1,455 acres, 7% as Class 3...The remaining 2,053 acres were mainly Class 6 land, suitable only for pasture land and grazing, and could not be considered a serious loss to agriculture.[123]

The article further points out that these class 1-3 lands could have produced 80,000,000 bushels of wheat over the next 100 years. Dr. Toogood, also discussed the proposed location of a new airport to serve Edmonton west of Villeneuve. The airport would occupy 585 hectares (1,445 acres) of which 50% would be Class 1 agricultural land and 45% Class 2.

Losses of agricultural land due to the expansions of Edmonton and Calgary between 1966 and 1973 are shown in the figure on the following page.

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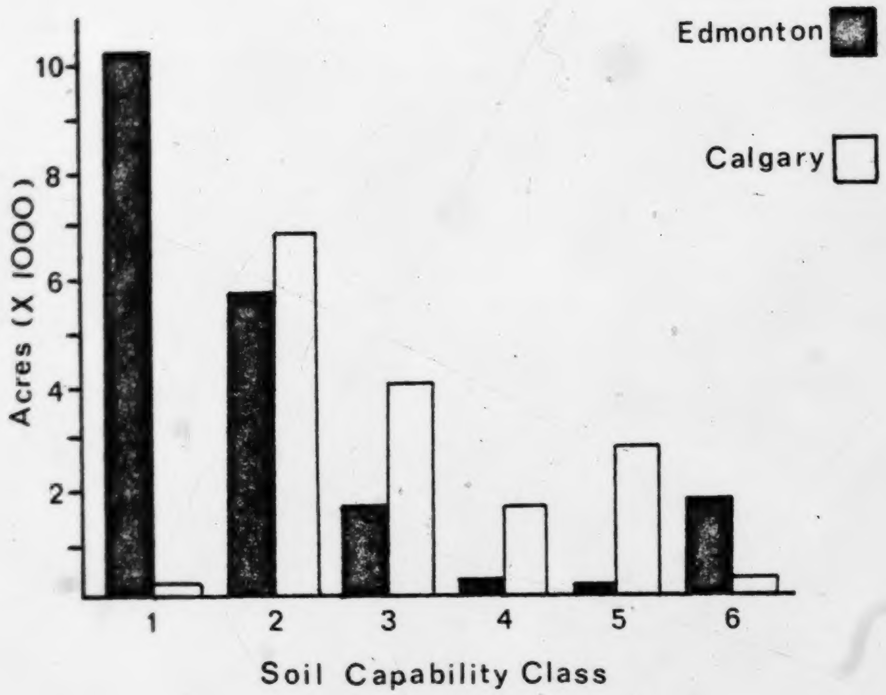
[123] Dr. J. A. Toogood, Our Soils are not Expendable, Edmonton Journal, Thursday, May 30, 1974.

FIGURE 1



Number of acres of each Soil Capability for Agriculture Class taken by the Urban development of Edmonton and Calgary between 1966 and 1973.

Source: P. H. Crown and S. S. Kocaoglu Land Use Conflict in Alberta: Agriculture vs. Urban Developments, Agriculture Bulletin, University of Alberta, No. 25, Fall 1974.

In 1973, the Alberta Government established the Land Use Forum to consider various aspects of land use in the Province. Of prime importance was the use of agricultural lands.

Technical Report No. 5, Future Land Needs for Agriculture has utilized available soil capability information. It compares improved acreage figures with soil capability classes 1 to 4 which are considered to be suitable for cultivation.

TABLE 52

POTENTIALLY ARABLE LANDS IN ALBERTA

Soil Group	Class 1 - 4	Total Improved Acres	Potential Arable Acres
Brown	5,776,965	4,733,527	1,043,438
Dark Brown	7,796,245	5,606,804	2,190,160
Black	12,696,365	11,036,635	1,448,730
Dark Grey	6,131,200	4,456,218	1,674,982
Grey Wooded	14,897,800	2,609,350	12,338,450
Total	47,197,575	28,341,814	18,855,761

Source: Alberta Land Use Forum, Technical Report No. 5, Future Land Needs for Agriculture, 1974.

"The validity of the estimate of 18.8 million acres of potential acreage assumes that the total acreage in Class 1 - 4 will be cultivated and that marginal land now in cultivation that actually may be class 5 will remain in cultivation." [124] The majority of this 7,630,656 hectares (18,855,761 acres) 65.7% is in the grey wooded soil group and it is questionable just how productive these soils will be and whether they should be in the Class 1 - 4 category at all. This is even more uncertain since most studies include only Classes 1 to 3 as being improved. The potential for agricultural expansion is certainly not as great as indicated in this report.

A report prepared by the Edmonton Regional Planning Commission for the Land Use Forum, Country Residential Survey - Parkland County, Technical Report #4A, considered existing country residential development within the county in terms of agricultural capability. Classes 1 and 2 were considered good agricultural land, and of 136 subdivided quarter sections, 22 were found to be located on these lands. Twenty-seven quarter sections contained Classes 3 and 4, and 87 were found on marginal lands classed as 5, 6 and 7.

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[124] Alberta Government, Land Use Forum Future Land Needs for Agriculture, Technical Report #5, prepared by Hu Harries and Associates Ltd., 1974, p. 36.

At the beginning of 1975, the Land Use Forum held public hearings in fifteen locations throughout the province. The hearings provided an opportunity for the public to express their concerns on land use in Alberta and a total of 209 briefs were presented. The Planning Services Division of Alberta Municipal Affairs attended these hearings, and the following comments dealing with agricultural capability were obtained from the report that was prepared by the Division - Summary and Index of the Land Use Forum Public Hearings. The information contained in the report was hand recorded from the verbal presentations at the hearings and the comments, may be different from those actually spoken by the participants. As the Summary and Index of the Land Use Forum Public Hearings is not an official transcript, the names of those making the presentations will not be footnoted.

Of the 209 briefs presented approximately 40 dealt with some aspect of the soil capability classification for agriculture. This is a good indication of the public's awareness of the classification.

The following comments were presented in Lethbridge:

(a) All Class 1 and 2 land must be preserved for agriculture.

(b) In the Lethbridge region agriculture is the prime use on Class 1 to 6 lands.

(c) Country residences should be confined to cluster developments on Class 5, 6 and 7 lands.

(d) Recreation areas should be set up only on Class 5, 6 and 7 land.

(e) All lands in C.L.I. Class 1-4 should be restricted to agricultural use forever.

Hearings held in Peace River

Hobby farms and country residences should be confined to Class 5-7 agricultural land.

Hearings held in Grande Prairie

Subdivision should not be allowed on Classes 1-4 land.

Hearings held in Calgary

(a) Agriculture should be the priority on Class 1, 2 and 3 soils.

(b) Food production must be high priority. Only 2% Classes 1-3. Most of the land around Calgary is Class 1-6. 6,070 hectares (15,000 acres) lost between 1972-1973 of which 70% was Class 1 to 3.

(c) Should not build on Class 1, 2 and 3 agricultural land and must also consider preserving other agricultural areas.

(d) 17% of Alberta is Class 1, 2 and 3 agricultural land. All ten provinces should zone these Classes (1-3) for agriculture.

(e) The expansion of Edmonton and Calgary on classes 1-3 land must be stopped.

(f) Only Canadians should own Class 1, 2 and 3 lands.

(g) Class 1 and 2 soils should be protected for agricultural production.

(h) Class 1 and 2 soils should not be subdivided below the quarter section level.

(i) The County of Foothills should not allow subdivision on Class 1-4 lands.

(j) The County of Wheatland should not allow Cominco/C.I.L. to locate on Class 1-3 lands.

Hearings held in Edmonton

(a) 1.1% of province is Class 1, 5.7% Class 2, 10.9% Class 3, 14.9% Class 4, and 17.7% Class 5.

(b) Classes 1-4 are potentially arable with 4 being marginal. Class 5 is good for forage.

(c) Soil capability classification should be used as a guide for Spring wheat.

(d) Class 1 to 3 land should be saved for agriculture.

(e) Class 2 and 3 agricultural land will be lost due to expansion of coal production at Forestburg.

(f) Subdivision of Classes 1 and 2 land is not permitted in Battle River Regional Planning Commission.

(g) Highest potential of Classes 1, 2 and 3 lands is for food production.

(h) Moratorium should be placed on subdivision of Classes 1, 2 and 3 lands. Class 4 to 7 should also come under zoning when highest priority is for agriculture.

(i) No comprehensive effort to use soil capability classification as a guideline has been made by government.

(j) Soils Class 1, 2 and 3 should never be used for anything but agricultural production. At present this land is being wasted - Villeneuve airport, Leduc annexation, Edmonton urbanization, divided highways.

(k) Provincial government should develop zoning of province on basis of best use of land (C.L.I.) Until there is legislation there should be a freeze on subdivision of Class 1, 2 and 3 lands.

(l) Preventing subdivision of good land may mean great rise in cost of Class 4 to 7. Speculation should be prevented.

(m) Any land held by speculators now in Class 1, 2 and 3 and undeveloped should be returned to agriculture and purchased by the government.

(n) Urban expansion must occur in Classes 4 to 7.

(o) Industrial development should not be permitted on Class 1, 2 and 3 soils.

(p) Energy corridors and roads should not be permitted on Class 1, 2 and 3 soils unless necessary.

(q) Class 1, 2 and 3 agricultural land should be protected from mining until no other choice is available and reclamation has been perfected.

Hearings held in Edson

(a) Class 3 and 4 soils are highly productive for forest crops but also needed for agriculture in this area. C.L.I. classification is based on wheat - not relevant in this area. If only

Class 1, 2 and 3 protected for agriculture, the purpose of the classification is defeated. Class 4 and 5 are both good for pasture.

(b) Class 1, 2, 3 and 4 agricultural land should be zoned for agriculture. The results of these hearings clearly indicate that the public feels Class 1 to 3 agricultural land should be preserved for agriculture. Although some regional planning commissions and rural municipalities have adopted this policy, the Provincial Government has not enacted any legislation in this direction.

In 1976, the Land Use Forum released its final document, Report and Recommendations. The report indicates that the Provincial Government has a responsibility in protecting agricultural land. "Number 1, 2 and 3 agricultural land should not be used for purposes other than agriculture without an assessment being made of all factors, including the availability of land for the change and the alternatives and long and short-term implications of changing the use of the land." [125] This statement is not presented as a recommendation but as an example of a land use guideline which could be considered.

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[125] Alberta, Land Use Forum, Report and Recommendations, 1976, p. 41.

In the section of the report on country residential development the Forum recommends that only poorer agricultural land should be used for this purpose, but it does not specify the class levels from the soil capability classification.

Although the soil capability classification received considerable exposure in the technical reports and public hearings of the Land Use Forum, it has received minimal attention in the Report and Recommendations. It appears that the Alberta Government wants flexibility in making land use decisions and is not willing to commit itself to protecting specific soil capability classes as recommended in the hearings.

The Alberta Regional Planning Commissions have utilized the agricultural capability classification at various levels. In the 1973 report Physical Environment Inventory, prepared by the Red Deer Regional Planning Commission the soil capability ratings are grouped into four categories. Category A is composed of Class 1 and 2 soils, Category B Class 3 and 4, C Class 5 and 6, and D 7 and O (organic). The study stresses the importance of the Class 1 and 2 soils and indicates that it is in these areas that the greatest land use conflicts will arise.

> Edmonton and Calgary, together with the transportation corridor between them, are situated within a belt of black soils. Today and more so in the future, urban, industrial, transportation and related uses are strongly competing with agricultural pursuits for the use of these Class 1 and 2 soils. Since these soils are finite, it appears that steps should be taken to preserve their use for agricultural production...."[126]

The most important use of the soil capability for agriculture classification by the regional planning commissions has been in the establishment of policies and guidelines for the use of agricultural land. The adopted Preliminary Regional Plan of the Oldman River Regional Planning Commission prepared in 1974 has used the classification to designate areas for agriculture.

> Policies - 1. Agriculture shall be considered the predominant use of land within the regions in areas covered by Canada Land Inventory soil capability classifications 1 to 6, except if also C.L.I. recreation classification 1 to 3. 2. All prime agricultural land, namely C.L.I. soil capability classifications 1 and 2, shall be reserved for this purpose, except if otherwise provided for by the Plan or by more detailed information which would indicate that the soils are actually of a lower classification (i.e., information provided by the Department of Agriculture, Irrigation District or Municipality)...6. The following conditional activities may be considered on prime agricultural lands, namely C.L.I. soil capability classifications 1 and 2:
>
> (a) urban uses which by their nature cannot be provided for within the confines of an urban municipality, including hamlets and other urban areas,

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[126] Red Deer Regional Planning Commission Physical Environment Inventory of the Red Deer Regional Planning Commission Area, 1972-73, p. 33.

> (b) airports, and
>
> (c) livestock confinement operations in each of these cases, sufficient evidence must be brought forth to indicate that no suitable alternative areas could be obtained on other lands, i.e., C.L.I. soil capability classifications 3 to 6.
>
> 7. All uses other than extensive agriculture shall be classified as conditional uses in C.L.I. soil capability classifications 3 to 6; and that they should be subject to all other provisions of this Plan.[127]

The Preliminary Regional Plan of the Battle River Regional Planning Commission prepared in 1976 establishes that agriculture must have priority in any land use conflicts on good soils. The following statement defines this policy

> Rural land which is capable of producing a good cereal or forage crop should be preserved for agriculture. As a general guide, this means Class 1, 2 and 3 soils east of the climate line marked on the C.L.I. sheets, and also Class 4 soils west of the climate line. The Commission recognizes that the Canada Land Inventory soil ratings are not exact, so in any doubtful case, the District Agriculturist will be consulted.[128]

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[127] Oldman River Regional Planning Commission, Preliminary Regional Plan, 1974, cited in Castle River Valley Pilot Study, Oldman River Regional Planning Commission, 1977, pp. 123-124.

[128] Battle River Regional Planning Commission, The Preliminary Regional Plan, 1976, p. 16.

The policy of the Edmonton Regional Planning Commission on the subdivision of agricultural land is as follows:

> The Commission has opposed the unwarranted fragmentation of good agricultural land for non-agricultural purposes. The Commission has used the ARDA Soil Capability Rating as a guide. Under these ratings #1, 2 and 3 soils are good agricultural soils. Where these #1, 2 and 3 soils are fully cultivated, they are not considered for Country Residential Subdivision. Where #3 soils are in association with #4 soils, and are under bush and trees, the Commission will consider the possibility of Country Residential development on the basis of the merits of the application and a favourable recommendation from the affected municipality.[129]

The Commission has also qualified their use of the soil capability classification in the report Rural Land Use Policy published in 1975. Classes 5 to 7 were not considered critical for agriculture and 4 appeared to be marginal. Classes 1 and 2 were considered prime agricultural land with 3 being on the borderline. Recognizing the limitations of the classification in terms of accuracy and scale the Commission has indicated that further information may be required in handling subdivisions. In dealing with complex areas the Commission

> will ask the applicant to engage a professional consultant to carry out a more detailed capability study of the land in question. This is needed because there is a limit to how many units can be mapped at the scale at which the C.L.I. was prepared.

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[129] Edmonton and Battle River Regional Planning Commissions, The Pigeon Lake Study, 1975, p. 93.

> The Commission will then average out the capability of the land on a weighted area basis. That is, if the total area of land in Classes 1, 2 and 3 put together is greater than the total area of land in Classes 4 to 7 plus 0 inclusive, then the land will be declared to have a prime agricultural rating.[130]

The Commission further indicates that the study should be done by a professional agrologist and a mere enlargement of the soil capability map is not acceptable. This is a realistic approach to the use of the classification. The limitations are recognized and a solution offered for the use of the soil capability classification in dealing with subdivision applications.

The policy of the Peace River Regional Planning Commission is similar to those already discussed.

> Where the bulk of land is highly productive or has potential for high productivity (Classes 1, 2, 3 and 4 according to the Canada Land Inventory, Soil Capability for Agriculture map series supplemented by a site inspection where necessary) subdivision will not be allowed... Subdivisions may be approved for hobby farms only where the land is not class 1 to 3 agricultural land.[131]

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[130] Edmonton Regional Planning Commission, Rural Land Use Policy, Regional Plan Project, Position Paper No. 1, 1975, pp. 44-45.

[131] Peace River Regional Planning Commission Patterns for the Future, A Regional Policy Plan for the Peace River Region of Alberta, 1976, pp. 14, 42 and 43.

In addition to the Regional Planning Commissions a number of rural municipalities have also established land use policies based on the soil capability classification in their zoning and development control bylaws. The General Plan for the Municipal District of Sturgeon, adopted in 1972, has established two agricultural zones. "The two areas of major importance to the agricultural industry are indicated on the Land Use Development Guide: (a) the better agricultural area where more than 60% of soils are in soil capability Classes I and II and where it is desirable to keep the better land in consolidated parcels, and (b) the secondary agricultural area where the soils are still generally good, having more than 60% in soil capability Classes II and III."[132]

The zoning bylaw for the County of Thorhild prohibits country residential subdivisions on lands having a soil capability rating of Class 3 or higher. The County of Strathcona, through their development control bylaw restricts country residential subdivisions from Class 1 and 2 land. The General Plan for the Municipal District of Rocky View states that agricultural lands with a capability of 1 and 2 should be preserved for farming.

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[132] Municipal District of Sturgeon General Plan, 1972, as cited in Provincial Land Use Policies - Background Paper, Planning Services Division, Alberta Municipal Affairs, 1976, p. 31.

The use of the soil capability classification in Provincial Policy in Alberta is almost non-existent. The one exception is the Coal Development Policy for Alberta that was released in 1976. The classification is referred to in Category 3 "in which exploration is desirable and may be permitted under appropriate control but in which development by surface or underground mining or in-situ operations will be approved subject to proper assurances respecting protection of the environment...This Category includes Class 1 and 2 agricultural lands in the settled regions of the province...the government will require appropriate assurances, with respect to surface mining operations on agricultural lands, that such lands will be reclaimed to a level of productivity equal or greater than that which existed prior to mining."[133]
Although this section of the Coal Policy is quite vague, it is an indication that the Provincial Government is aware of the classification.

3. Land Capability Classification for Forestry

Although the Forestry classification is the most detailed of all the classifications its utilization has been limited. Most forest operations in Alberta occur on Crown lands and the public has little interest in the forest capability of these areas. More concern is expressed over existing volumes of timber than in the potential of the land to produce it. The use of the classification has been primarily confined to resource agencies within government but very little information on this use has been published.

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[133] Alberta Government, A Coal Development Policy for Alberta, Department of Energy and Natural Resources, 1976, p. 16.

(a) Utilization in Atlantic Canada

In New Brunswick the forest capability maps have been used as a guide in the identification of areas where forest stand improvements such as scarification, fertilizing and planting could be carried out. The maps were used in assessing areas that would respond to spray treatment in a Spruce Budworm control program. In addition, the classification has been considered as a base in establishing assessments for taxation purposes.

In Newfoundland, the classification has been used in revising and improving forestry legislation, and in Nova Scotia it has been used as an input in creating improved forest management plans.

The Mactaquac Regional Development Plan in New Brunswick has assigned forestry to one of two groups. Group one is considered suitable for economic production of timber and is composed of Class 2 and 3 forest capability. The second group Class 4 to 7 is generally considered unsuitable for intensive silvicultural practices. The report indicated that a pulp mill was being considered for a particular site based in part upon the forest capability classification. "A firm is giving serious consideration to the establishment of a pulp mill as part of its expansion program, against a background of results from the forestry inventory and capability studies which indicate that a wood-processing complex might profitably be located near Cullerton."[134]

(b) Utilization in Ontario

The forestry capability classification was used by the Ontario Department of Energy and Natural Resources in the report Northwestern Ontario - Background Information and Approach to Policy. The seven classes of the forestry classification are generalized into four Categories, high, moderate, low and very low, but no indication is given of the class ratings in each category.

In the Countryside Planning Study for Huron County prepared for the Ontario Ministry of Housing it is indicated that a forestry perspective is not applicable in southwestern Ontario due to a lack of merchantible forests. The report does, however, contain a generalized forest capability map divided into three categories. The first category covers Class 1, the second Class 2 and the third Classes 3, 4 and 5.

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[134] New Brunswick ARDA Committee, H. C. Acres & Company Ltd., Mactaquac Regional Development Plan - Summary Report, 1965, p. 55.

(c) Utilization in Alberta

In Alberta, the Red Deer Regional Planning Commission discusses the forestry potential of their region in the report Physical Environment Inventory. The forestry capability map which is included in the report generalizes the classes into three categories. Category one consists of Class 3, Category 2 - Class 4 and 5, and Category 3 - Classes 6 and 7.

The Land Capability Classification for Forestry in Alberta report prepared by the Department of Energy and Natural Resources indicates that private industries have used the forest classification for forest management and environmental impact studies. The report further indicates that the classification can be used to identify areas of high potential for forest production, as a guide in identifying wildlife habitat, and in the planning of recreational developments.

> Information from C.L.I. maps can be used in silvicultural planning. Priorities for reforestation programs, which are carried out annually in Alberta, should be on areas where maximum returns can be expected. Factors such as proper species selection and potential regeneration problems can be partially assessed from the information presented on maps and in the area descriptions. The data, while not specific enough for detailed silvicultural planning on individual sites, can be used as a guideline.[135]

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[135] Alberta Department of Energy and Natural Resources, Land Capability Classification for Forestry in Alberta, E.N.R. Report No. 6, 1976, p. 76.

Reference is made to the forest classification in the report, The Environmental Effects of Timber Harvesting Operations in the Edson and Grande Prairie Forests of Alberta which was prepared in 1973 for the Alberta Forest Service by C.D. Schultz and Company Ltd. Capability information from several sample plots located in the study area was quoted.

An overview of the forest capability classification for Alberta can be obtained from the published 1:1,000,000 map which covers the entire province. The map was prepared by generalizing information from the 1:50,000 sheets; however, it does not contain limitations and indicator species.

4. Land Capability Classification for Recreation

The Land Capability Classification for Recreation has been utilized to identify lands that have potential for recreational purposes. Studies have concentrated on the shoreland portion of the classification indicating beach areas and potential cottage sites. In most land use studies it provides an initial overview of the recreational capability, which is best shown through the inclusion of the relevant 1:50,000 or 1:250,000 maps.

(a) Utilization in Atlantic Canada

In a Prince Edward Island study the land capability classification for recreation was used to quantify the length of salt water shoreline in each capability class. It was determined that 57% of the 1,107 kilometres (688 miles) of shoreline of the Province was class 1, 2 or 3. Class 1 and 2 accounted for 388 kilometres (241 miles). Although not indicated in the study, (Land Use Programs in Canada, Prince Edward Island, Environment Canada, 1974), it is assumed that most of these shoreline units contained a B (beach) as a dominant feature. The recreation classification in this example was used to show the loss of beach lands to private ownership and idle use in P.E.I. Between 1968 and 1971 approval was given for the creation of 3,870 cottage lots but only 569 building permits were issued.

(b) Utilization in Ontario

E. M. Cressman in his report North Georgian Bay Recreational Reserve - A Land Use Approach prepared in 1970 has utilized the Ontario Recreation Land Inventory in determining the capacity of various classes of shoreline for cottages as indicated in table 53.

TABLE 53

CAPABILITY FOR COTTAGING - ONTARIO LAND INVENTORY

Class	Capability	Number of Cottages per mile of Shoreline
1	very high	64+
2	high	32 - 63
3	moderately high	16 - 31
4	moderate	8 - 15
5	moderately low	4 - 7
6	low	1 - 3
7	very low	less than 1

Source: E. M. Cressman, North Georgian Bay Recreational Reserve - A Land Use Approach

Although these figures give some indication as to the number of lakefront cottages that can be permitted according to class, no indication is made as to the intensity of back-lot development. The same is true for the Land Capability Classification for Outdoor Recreation manual which indicates that Class 3 shoreland can support cottages every 30.5 metres (100 feet), Class 4 every 61 metres (200 feet) and Class 5 every 152 metres (500 feet).

Planning agencies are attempting to encourage cluster-type cottage subdivisions and these figures often are more harmful than beneficial for they promote private cottage shoreline development, and often in areas which should be used for public, multi-user development.

The Capability Classification for recreation has been used in the Background Information and Approach to Policy report prepared for Northwestern Ontario by the Ministry of Natural Resources in 1974. Recreation capability was described as being intensive or extensive. Intensive recreation included areas of outstanding and high capability while extensive included areas of high, moderate, low and very low capability. Although class ratings were not assigned to these categories they appear to be quite similar to the C.L.I. ratings.

The report also indicates that country residential development should not be permitted on Class 1 - 3 recreation lands.

In Countryside Planning, a Pilot Study of Huron County, use has also been made of the land capability classification for recreation. It is indicated in the policy section of the study that areas with a recreation potential of 1 to 4 and an agricultural rating of 4 to 7 should be designated for local recreation purposes.

The recreation perspective further indicates that the following lands should be preserved; "Significant sections of the shoreline (one mile or more) with a (C.L.I.) recreation capability rating of

Classes 1, 2 or 3; where a river valley or some other recreation resource of C.L.I. recreation capability Classes 1 to 4 extends the recreation potential further inland and where there is an existing or proposed recreation use other than seasonal residential." [136]

(c) Utilization in Alberta

In 1969 J. J. Nowicki completed a thesis in the Geography Department of the University of Alberta entitled Recreational Capability and Use of Some North-Central Alberta Lakes. Mr. Nowicki has used a modified version of the C.L.I. Capability Classification for Recreation in describing the recreational potential of the lakes within the study area. Class 1 and 2 beach categories have been modified to establish a distinction between outstanding and excellent beaches. This modification is shown in table 54.

The limitations used in the study are those that were initially developed in the pilot projects of the C.L.I. Land Capability Classification for Recreation in 1964/65. They have been briefly discussed in the section of this thesis which dealt with the reliability of the capability classification for recreation.

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[136] Ontario, Ministry of Housing, Countryside Planning, A Pilot Study of Huron County, 1976, p. 166.

TABLE 54

REFINED CLASS 1B AND 2B CATEGORIES

Class	Criteria
1 + B	Class 1B with no limitations
1 - B	Class 1B with 1 limitation point
2 + B	a) 1,000 feet of beach with 2 limitation points, or
	b) 300 feet of Class 2B with no limitations
2 - B	a) 1,000 feet of beach with limitation points, or
	b) 300 feet of Class 2B with 1 to 3 limitation points

Source: J. J. Nowicki, Recreational Capability and Use of some North-Central Alberta Lakes, Geography Department, University of Alberta, 1969.

Based on the number of units of shoreline in Classes 1 to 3, the author has ranked the lakes according to their potential capability for recreation. An example of this ranking is shown in the following table:

TABLE 55

TOP LAKES BASED ON THE NUMBER OF UNITS IN FIRST THREE CLASSES FOR EACH LAKE

	Ranking	Class 1B Units	Class 2 Units	Class 3 Units	Total
Cold	1	11	18	36	65
Frog	2	7	14	22	43
Lac La Biche	3	5	14	15	34
Wolf	4	0	7	14	21
Marie	5	4	2	14	20
Touchwood	6	1	3	13	17
Muriel	7	2	5	8	15
Moose	8	0	1	12	14
Moore	9	1	2	9	11
Ironwood	10	0	5	5	10

Source: J. J. Nowicki, Recreational Capability and Use of some North-Central Alberta Lakes, Geography Department, University of Alberta, 1969.

Although this ranking gives an indication of the recreational capability of the lakes in the study area, it could be somewhat misleading as it is based on number of units rather than the length of shoreline in each class. For example, a Class 2 beach can vary in length from 91 to 305 metres (300 to 1,000 feet) (305 metres (1000 feet) is minimum distance for Class 1 beach). The total length of the 14 class 2 units on Lac La Biche, assuming that they are all beaches, could vary from 1,280 metres to 4,267 metres (4,200 feet to 14,000 feet).

In the spring of 1972, the Alberta Provincial Planning Board and the Conservation and Utilization Committee of Alberta Environment established a task force to evaluate the subdivision of land adjacent to water bodies. The task force was to investigate methods of improving the Subdivision and Transfer Regulation as it pertains to cottage subdivision

The land capability classification for outdoor recreation was utilized in identifying areas suitable for cottage developments, and the guidelines recommended for implementation are shown in table 56.

This table illustrates an attempt to utilize both class and sub-class ratings in determining the size and location of cottage lots. However, it is difficult to establish such rigid dimensions, for shorelines and conditions vary considerably throughout the province. In many areas of Alberta, Class 1 - 3 shoreland is non-existent and lower class land must, therefore be reserved for public uses.

Although these guidelines were never incorporated in the Subdivision and Transfer Regulation they did indicate the importance of the C.L.I. in identifying high capability shoreline.

The Preliminary Regional Plans, Patterns for the Future prepared by the Peace River Regional Planning Commission in 1976 has utilized the land capability classification for recreation in designating lakeshore corridors. "The Commission will designate the perimeters of the region's lakes as Lakeshore Corridors as follows: Where the land borders on a water body any portion of whose shoreline has Canada Land Inventory outdoor recreation capability of Class 4 or better, the Lakeshore Corridor shall comprise that part of the land which lies within 400 feet of the water body."[137] These guidelines have been adopted from the Land Conservation Regulations of the Alberta Land Surface Conservation and Reclamation Act.

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[137] Peace River Regional Planning Commission, Patterns for the Future, A Regional Policy Plan for the Peace River Region of Alberta, 1976, p. 38.

TABLE 56

RECOMMENDED GUIDELINES FOR COTTAGE SUBDIVISIONSUSING C.L.I.

Class	Subclasses (features)	Width of the Undeveloped Zone	Min. Width if Frontage	Min. Width if Not Frontage	Min. Length	Min. Area
1	All subclasses	No Subdivision				
2	Dominant subclasses B, K, Y	1,000 feet	100 ft.	100 ft.	200 ft.	20,000 sq. ft.
	N - either dominant or subordinate (unless B, K, Y dominant)	300 feet	100 ft.	100 ft.	200 ft.	20,000 sq. ft.
3	Dominate subclasses B, K, Y	500 feet	100 ft.	100 ft.	200 ft.	20,000 sq. ft.
	N - either dominant or subordinate (unless B, K, Y dominant)	100 feet	200 ft.	100 ft.	200 ft.	20,000 sq. ft.
4	N - either dominant or subordinate	100 feet	200 ft.	100 ft.	200 ft.	20,000 sq. ft.
	All other subclasses	300 feet	200 ft.	100 ft.	200 ft.	20,000 sq. ft.
5	N - either dominant or subordinate	100 feet	200 ft.	100 ft.	200 ft.	20,000 sq. ft.
	Other subclasses	No subdivision				
6, 7	No subdivision					

Source: Provincial Planning Branch, Alberta Municipal Affairs, Proposed Regulations for the Location and Development of Cottage Subdivisions, 1972.

The Red Deer Regional Planning Commission has more recently developed standards (see table 57) for lakeshore activities based on the Canada Land Inventory. The Commission has recommended that these standards be adopted as guidelines. In the absence of more precise data upon which to base standards it is indicated that they be used cautiously.

The Planning Commission has expanded figures indicated in table 57 to determine standards for various activities associated with beach use. Area figures based on the recreation classes 1 to 6 have been calculated for picnic, parking and overnight units. The study indicates that 1.6 kilometres (one mile) of class 1 beach requires, in addition to the 14.71 hectares (36.36 acres) needed for beach activities 497 hectares (1228 acres) for these related activities (units). The C.L.I. Field Manual-Land Capability Classification for Outdoor Recreation prepared in 1967 indicates that 10 hectares (25 acres) of developable backshore suitable for supporting playgrounds, picnic areas, campgrounds, parking areas, etc. is required for every 305 metres (1,000 ft.) of class 1 beach. Accordingly 1 mile of class 1 beach would require 53 hectares (132 acres) for support activities. This is significantly smaller than the 497 hectares (1228 acres) indicated in the study of the Red Deer Regional Planning Commission, These differences clearly indicate that the reliability in quantifying the recreation classification is questionable.

TABLE 57

RECOMMENDED MAXIMUM BEACH USE AT ANY ONE TIME BY RECREATION CLASS

Shoreland Recreation Class	Sq. Ft. Per User	People/ Acre	Units/ Acre(1)	Units/ Mile(2)	People/ Mile(3)
1	150	290.4	72.6	2640	10,560
2	225	193.6	48.4	1760	7,040
3	325	134.0	33.5	1218	4,872
4	450	96.8	24.2	880	3,520
5	600	72.6	18.2	660	2,640
6	800	54.5	13.6	495	1,980

(1) four persons per unit or recreation party (group)

(2) 5,280 ft. beach by 300 ft. wide = 36.36 acres

(3) units per mile x 4

Note: These standards are for a recreation shoreland with a Beach activity listed as the primary use as designated by the Canada Land Inventory. Lower by one class if prime status is any other desirable type of recreation activity.

Source: Red Deer Regional Planning Commission, Regional Lake Perspective: Inventory and Policy Directions, 1976.

In the Preliminary Regional Plan for the Battle River Regional Planning Commission, the land capability classification for recreation has been used to designate areas where intensive livestock operations will not be permitted. "Except with the explicit approval of the local Health Unit, no intensive animal operation should be established so that any part is on or within one mile of land classified as "shoreline" and rated 1, 2 or 3 by the C.L.I. Land Capability for Outdoor Recreation." [138] The Pigeon Lake Study prepared jointly by the Battle River and Edmonton Regional Planning Commission in 1975 makes use of the recreation capability classification in describing the potential of the shoreline for recreation. The shoreline is divided into four categories which are primarily based on C.L.I. recreation ratings. The first category which includes the beach areas is primarily Class 1. The second category has low backshore and offshore gradients but lacks the beaches of the first category. It is primarily Class 3. The third category exhibits very gentle offshore gradients which support marsh vegetation and thus is suited to waterfowl production. Most of this shoreline is rated as Class 6. The fourth category is characterized by steep slopes in the foreshore; however, the backshore in this category offers impressive view sites for cottages. These areas are predominantly Class 3.

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[138] Battle River Regional Planning Commission, The Preliminary Regional Plan, 1976, p. 17.

In this study, the characteristics of the seven class capability classification for recreation have been incorporated into four categories which are based primarily upon geomorphological parameters of the shoreline. These parameters generally dictate the type of development which is best suited to each of the four categories.

The Land Capability for Recreation is referred to briefly in the policy statement on Outdoor Recreation and Open Space in the Preliminary Regional Plan of the Oldman River Regional Planning Commission. "Since (unlike the rest of Canada) there are not areas in the region with a Canada Land Inventory recreation capability of Class 1 and few with a Class 2 or 3 capability, land use policies in these areas shall favour recreational uses and all non-complementary land uses shall be limited or prohibited." [139]

The recreational potential of the Red Deer River Regional Planning Commission area is discussed in the report Physical Environment Inventory. As in many other studies, the seven class rating system of the recreation capability classification has been abbreviated into four categories. Category one is composed of Classes 1, 2 and 3; category two - Class 4; category three - Class 5 and category four - Classes 6 and 7.

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[139] Oldman River Regional Planning Commission, Preliminary Regional Plan, 1974, cited in Castle River Valley Pilot Study, Oldman River Regional Planning Commission, 1977, p. 126.

The following typical statements taken from the study represent the primary utilization of the land capability classification for recreation.

> Three small areas in this region have received Class 1 designation. One is on the west boundary of the Commission on the Cline River Valley, its very high potential being for skiing, viewing and topographic variations. The other two are lakeshore lands bordering Gull and Buffalo Lakes. The Gull Lake site at Aspen Beach has very high potential for its beach, boating, water skiing and camping facilities....
>
> In the mountains and foothill zones, the Class 2 lands have high capability usually for viewing, skiing and topographic variation and sometimes for angling, unusual vegetation, waterfalls and camping....
>
> On the plains, Class 3 recreation lands are assigned to some lakeshore and stream valleys, with boating, water skiing, camping and lodging being the uses with the highest capability....
>
> Class 4 lands are usually found in mountain valleys or around larger lakes. In the mountains, viewing, landforms, vegetation appreciation, angling and camping are often signified as important recreation aspects while on the prairies, topography, wildlife and viewing have special significance....
>
> Class 5 lands are widespread throughout the foothills and plains. Viewing, wildlife, vegetation and topography are the attributes most often cited for recreation capability in these zones. Class 6 lands are also extensive throughout the prairies and mountains and have recreation significance for uses similar to Class 5 lands. Class 7 lands are restricted to muskeg areas around Rocky Mountain House with some significance for wildlife and vegetation studies.[140]

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[140] Red Deer Regional Planning Commission, Physical Environment Inventory of the Red Deer Regional Planning Commission Area, 1972/73, pp. 61 - 63.

Except in the case of Class 1 areas, this generalized summary does not indicate the locations of the various class units. The recreation potential is indicated in terms of those features associated with the class ratings and their inherent vagueness is not conducive to recreational recommendations.

More detail is provided in the report Allocation of Land According to Renewable Resource Potential which was prepared for the Lesser Slave Lake Region by Alberta Municipal Affairs in 1974. The report indicates that Wallace Mountain in the Swan Hills is rated as Class 3 because of its potential for skiing and viewing. The Athabasca River, in the southeast of the region has some shoreline units rated as Class 4 for canoeing, camping and fishing. Rapids on the Wabasca River northeast of Peerless Lake and the West Prairie River on the western flanks of the Swan Hills are rated as Class 5. The Grouard Mission at the western end of Lesser Slave Lake is rated as a Class 5 historic site.

It is further pointed out in this report that

> the Lesser Slave Lake area contains 23 of the 34 (68%) Class 1 shoreland units classified in the province, 34 of the 102 (33%) Class 2 shoreland units and 186 of the 473 (39%) Class 3 shoreland units. The Lesser Slave area represents only eight percent of the classified area of the province but contains nearly forty percent of all Class 1, 2 and 3 shoreland units.[141]

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[141] Alberta Municipal Affairs, Provincial Planning Branch, Lesser Slave Lake Regional Plan, Rural Land Use Study, Section III, Allocation of Land According to Renewable Resource Potential, 1974, p. 63.

The Land Capability Classification for Recreation has also been used in the Northeast Alberta Regional Plan prepared in 1976. Due to a lack of high capability lands in the region, the report recommends that Classes 1 to 5 be considered as opportunity areas for recreation. Both lakes and upland areas are identified as having potential for intensive recreation but no capability ratings are given.

An environmental impact study prepared by the Lombard North Group for Imperial Oil in 1974 has used the recreation classification to evaluate the potential of insitu oil leases in the Cold Lake area of Alberta. As with most other evaluations it is purely descriptive and summarizes the capability into three categories - high (Class 1 and 2), moderate (Class 3 and 4), and low (Class 5, 6 and 7).

The terms of reference for the Alberta Land Use Forum included an analysis on the use of the Province's recreational resources. As a result, technical report No. 12 Use of Our Lakes and Lakeshore Lands was prepared by the Technical Committee on Lakes and Lake Shorelands under the direction of Alberta Environment. This report on a township basis locates Class 1, 2 and 3 shorelands within the province.

As part of this overall investigation of lake resources the Regional Planning Commissions and the Planning Services Division of Alberta

Municipal Affairs prepared background reports which documented the lake resource within their respective areas of jurisdiction. These reports categorized the lakes by recreation capability class indicating shoreland area in acres and length in miles on a municipal basis. In some areas this information was collected on a lake basis.

The preliminary study, Phase One: Lake and Lake Shoreland Study Lakeland Region prepared by Alberta Municipal Affairs in 1975 utilized this information in identifying lakes which because of their high capability warranted further study. In the Lakeland Region of Alberta over four hundred lakes in excess of 32 hectares (80 acres) were investigated and of these 24 were selected for further study. In order to qualify for further study it was required that the lakes have at least .32 kilometres (two-tenths of a mile) of Class 1 or 2 beach and be no more than .8 kilometres (one-half mile) from an existing all-weather road. As a result of this latter requirement a number of high potential recreation lakes were not identified for further study. This was not considered critical as they were surrounded by Crown land and did not face imminent development pressure.

The Land Conservation Regulations of the Alberta Land Surface Conservation and Reclamation Act have incorporated the land capability classification for recreation in order to regulate surface operations. The subdivision of land is exempt from these regulations, but they do cover a wide range of industrial activities. The Land Conservation Guidelines include the following references to the recreation classification.

> Where development land borders on or contains a waterbody, there shall be no development or distrubance, unless a greater or lesser distance is prescribed in the applicable Regulated Surface Operations Regulations or unless specific approval therefore is granted, of that part of the land that lies within: (a) 400 feet of the waterbody, if the outdoor recreation capability of the waterbody is Class 1, 2, 3, 4 or (b) such distance of the waterbody as the Approving Authority prescribes, which may be less than 400 feet but not less than a distance prescribed in section 6, if the outdoor recreation capability of the waterbody is Class 5, 6, or 7.[142]

The distance prescribed in section 6 is 30.5 metres (100 feet) of the waterbody where the area of the waterbody is 16.2 hectares (40 acres) or more.

The Parks, Outdoor Recreation and Open Space Policy prepared by the Edmonton Regional Planning Commission in 1976 indicates that the classification was useful in formulating regional recreational guidelines; however, no details are mentioned, and one would think that such a Policy report would have been based upon the recreation classification.

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[142] Alberta The Land Surface Conservation and Reclamation Act, Land Conservation Regulations, Schedule, Land Conservation Guidelines, Section 5, OC 815/74.

The report does provide a positive indication for the future use of the classification.

> Furthermore, within the context of the regional plan this recreational inventory information will be used along with other environmental and land capability information, in an analytical phase aimed at determining the highest and best use for each area of land. This information will contribute to the development of regional land use allocation policies, and will also serve as a data bank for subdivision processing and local municipal planning.[143]

The reconnaissance level of the recreation classification is initially stressed in the report and then as indicated above, details of how the classification will be incorporated into the regional plan are outlined. This suggests the uncertainty that exists regarding its use.

It is interesting to note that the Shorelands Policy prepared by the Edmonton Regional Planning Commission in 1976 does not include any reference to the land capability classification for recreation. One of the strong points of the classification has been the identification of high capability shorelands.

Like the other classifications, recreation capability is summarized on a provincial map at a scale of 1:1,000,000. On this map the seven classes have been combined into five groups - Classes 1 and

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[143] Edmonton Regional Planning Commission, Parks, Outdoor Recreation and Open Space Policy, Position Paper No. 3, Regional Plan Project, 1976, pp. 78-79.

2, Class 3, Class 4, Class 5 and Classes 6 and 7. The features or subclasses which are included on the 1:250,000 map sheets are not shown on this map.

In this section of the thesis some of the uses of the land capability classification for recreation have been documented. The subjective nature of the classification is reflected in its use, and it usually referred to as being of a reconnaissance type. This lack of detail has prevented the classification from being incorporated into many planning documents.

Recreation specialists indicate that the classification is too generalized for planning; yet the planner who is required to make land use decisions has nothing better to replace it with. This appears to be a very common problem in dealing with all of the C.L.I. classifications.

Experience in dealing with the classification has shown that it is best suited to providing an overview of recreational potential and the identification of areas which warrant further investigation. The allocation of land for recreational uses based alone upon the classification should not be made. Unfortunately, developers have used the classification to justify the subdivision of land for cottages; however, the classification is certainly not intended to be utilized at this level of detail.

5. Land Capability Classification for Ungulates

The Land Capability Classification for Ungulates has received little public attention and its use has been limited primarily to government studies. The ungulate maps have been used to identify areas of possible conflict between wildlife wintering ranges and resource exploitation. Within this classification land units are assigned according to physical characteristics and do not necessarily reflect present land uses. This has provided some confusion to those not experienced in utilizing the classification.

> One of the few documented cases of public use of the printed 1:250,000 sheets occurred when two hunters purchased the sheets covering the Peace River Region. After carefully noting the Class 1 ungulate areas, they drove all the way out to their chosen hunting spot only to find upon arrival, that it was all in farmland. Obviously, somebody had not informed them that the capability maps do not take into account present land use. [144]

Much of the high capability agricultural prairie land, including the Edmonton area has been rated as Class 2 with the indicator species being moose, elk and deer. Deer might be found in isolated bushland around the city, but one would certainly not find moose or elk.

Provincial wildlife agencies have used the ungulate classification in identifying critical habitat areas that should be maintained under Crown ownership. These agencies have been aided by the classification in the preparation of management plans for key wintering regions. In

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[144] Alberta, Department of Municipal Affairs, Provincial Planning Branch, Unpublished Report No. 6, Ungulate Capability Analysis, 1972. p. 4.

Manitoba, the classification was used to identify the Montagoo Lake area as being a suitable habitat for elk which were being transplanted from Riding Mountain National Park. In Newfoundland the capability maps were used to predict areas where moose browse damage was probable.

In the Land Use Study, South Side Riding Mountain National Park prepared by the Manitoba Department of Mines and Natural Resources in 1970, a five-point wildlife capability classification was developed. Class 1 was considered as being excellent, Class 2 - good, Class 3 - fair, Class 4 - poor and Class 5 was deemed to have no value for wildlife. These ratings were applied on a quarter-section basis throughout the study area. It is assumed that this five-point system is similar to the seven-point C.L.I. ungulate classification since the system was developed by the Wildlife Sector of the C.L.I. for Manitoba.

(a) Utilization in Alberta

The Northeast Alberta Regional Plan prepared by Ekistic Design Consultants in 1976 has identified ungulate Classes 1 to 3 as being opportunity areas and Classes 4 to 7 as constraint areas. In the conclusion portion of the study it is recommended that the Class 1 - 3 wintering areas in the region be preserved.

As with the other capability classifications the Red Deer Regional Planning Commission has referenced the ungulate classification in its study Physical Environment Inventory. The classes are grouped into four categories - (a) Classes 1 and 1W, (b) Classes 2, 2W, 3 and 3W, (c) Classes 4 and 5 and (d) Classes 6 and 7. The study indicates that the eastern half of the region has high ungulate capability which is attributable to the morainal uplands. In addition, the Red Deer and Battle River valleys provide wintering ranges. The western half of the Commission area has lower capabilities as it lacks soil nutrients which are important to plant growth. Mature woodlands throughout the area are generally poor for browse. Winter ranges are found along the many streams and rivers but they lack the morainic habitat of the eastern area.

The Environmental Study of the Cold Lake area prepared in 1974 by the Lombard North Group for Imperial Oil has made reference to the ungulate capability classification in describing wildlife potential. Twenty percent of the area has been rated as Class 2, 33% Class 3 and 47% Class 4. Included in these categories are important Class 2 and 3 wintering ranges.

The importance of winter ranges for ungulates is emphasized in the Castle River Valley Pilot Study prepared by the Oldman River Regional Planning Commission in 1977.

> The Castle River Valley serves as a prime winter range for mule deer and white-tail deer. Favourable habitat for elk is also found in the upstream sector of the valley. The valley is sought out by ungulates for several reasons. A variety of browse, an important food source is available. During the winter and early spring, south and west slopes are often swept bare of snow, thus permitting grazing. The sunny slopes are also favoured sites for the young in spring. The shrubs and trees along the valley bottom provide protection from the elements and at the same time, offer some measure of escape cover.[145]

The importance of wintering ranges is similarly emphasized in Physical Characteristics, Calgary Region Growth Study prepared by the Calgary Regional Planning Commission in 1977.

The capability classification for ungulates was an important element in the County of Athabasca County Residential Study completed by Alberta Municipal Affairs in 1977. In Alberta, land that is best suited for country residential development is usually equally suited as wildlife (ungulate) wintering range. The Athabasca and Tawatinaw river valleys in the County of Athabasca contain extensive Class 1 and W wintering areas which are critical to the survival of moose and deer in the region. Intensive country residential development, especially in the Tawatinaw valley could lead to the destruction of these wintering areas. The importance of this wildlife habitat is reflected in the recommendations of the report.

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[145] Oldman River Regional Planning Commission, Castle River Valley, Pilot Study, May 1977, p. 36.

> It is imperative that no country residential development be allowed in the Tawatinaw Valley outside of the sites designated by this report... at present, only portions of the valley have received detailed study by wildlife officers and hence, all critical wintering areas have not yet been identified. The sites designated in this study have been studied by a wildlife biologist. It is his opinion that the sites are not located on ungulate winter range lands and therefore, from a willdlife protection perspective are suitable for country residential development.[146]

The Ungulate Capability Classification has not been incorporated into provincial legislation in Alberta; however, it is included in the development guidelines of the Preliminary Regional Plan for the Battle River Regional Planning Commission. "The Commission believes that there are compelling reasons for maintaining the sizeable wildlife population in the region even at the expense of some loss of agricultural production...Municipalities should give protection to critical areas by means of zoning bylaws, ungulate winter range - this land is generally located in watershed protection areas so complementary zoning is both possible and desirable...the

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[146] Alberta Municipal Affairs, Planning Services Division, Regional Planning Section, County of Athabasca Country Residential Study Part One, 1977, p. 58.

Commission will protect these areas by allowing subdivision only when satisfied on the advice of a Regional Wildlife Biologist that the proposal will not significantly damage the habitat." [147]

An overview of Alberta's capability for ungulates is illustrated in the 1:1,000,000 scale map for the province. The classes on this map have been arranged in five categories. Category one is composed of Classes 1W, 2W, and 3W, category two - Classes 1 and 2, category three - Class 3, category four - Classes 4 and 5, and category five - Classes 6 and 7. The importance of wintering ranges within the classification is emphasized by this arrangement.

6. Land Capability Classification for Waterfowl

The utilization of the Land Capability Classification for Waterfowl is quite similar to that of the ungulate classification. Instead of wintering ranges important migration stops for waterfowl are emphasized. Use of the classification has been primarily limited to governmental personnel and environmental consultants. Public use has been limited to hunters who have obtained 1:250,000 map sheets as a guide in determining choice hunting locations. This has resulted in problems similar to those described for ungulates since the classification does not necessarily reflect present land use.

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[147] Battle River Regional Planning Commission, The Preliminary Regional Plan, 1976, p. 27.

(a) Utilization in Alberta

The waterfowl classification has been utilized primarily to describe the potential of a region as illustrated in the Physical Environment Inventory report of the Red Deer Regional Planning Commission. As in many descriptions, the classes have been grouped. Group A is composed of Classes 1 and 1S, Group B - Classes 2 and 3, Group C - Classes 4 and 5 and Group D - Classes 6 and 7.

The Calgary Regional Planning Commission in its report Physical Characteristics, Calgary Region Growth Study has developed three groups. Group One contains Classes 1, 2S, and 3M, Group Two - Classes 2 and 3, and Group Three Classes 4, 5, 6 and 7. (Classes 1S, 2 and 3S do not occur in the study area).

This grouping of classes as referenced here and in the other classifications often leads to confusion and misunderstanding and makes comparisons between regions cumbersome. One would experience difficulty in comparing the waterfowl maps of the Red Deer and Calgary Regional Planning Commissions. In one study Classes 4, 5, 6 and 7 are equally split into two categories, while in the other, all four are combined into one category.

A typical example of a waterfowl capability description is presented in the atlas entitled Historical and Regional Setting which was prepared for the Lesser Slave Lake Regional Plan.

> In relation to the province as a whole, the Lesser Slave Lake area is extremely limited in potential for waterfowl production. However, it does contain some excellent waterfowl production sites and is particularly important for migration stops since it contains four out of a total of sixty-one 1S, 2S, 3S and 3M sites in the province...The most favourable sites in the study area are concentrated around the major lakes in the northwest and west central portion of the area...The Class 1S northwest arm of Winagami Lake has the highest potential for waterfowl production in the area and also acts as an important migration stop. Little Buffalo Lake, Lubicon Lake and Lac Magloire are also Class 1 production sites with ideal conditions for waterfowl breeding...Since the Lesser Slave Lake area is fairly remote and far from major population concentrations, the potential of the area for waterfowl production is closely reflected in the actual situation. There has been little disturbance of the natural environment and hunting pressures are relatively light.[148]

The Edmonton Regional Planning Commission in Country Residential Survey - Parkland County which was prepared for the Alberta Land Use Forum in 1974 has identified an apparent relationship between land suited to waterfowl and that suited to country residential development. "It would appear that the amenity of the environment associated with high and moderate waterfowl capability areas attracts the country residential subdivision since these areas generally have small lakes often associated with an undulating terrain."[149] Of the 136 subdivided quarter-sections in the study area, 25% were situated on waterfowl capability class 1 and 2 land, 44% on class 3 and 4 and 31% on class 5 and 6.

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[148] Alberta Municipal Affairs, Planning Services Division, Regional Planning Historical and Physical Setting - Lesser Slave Lake Regional Plan, 1977, p. 24.

In terms of legislative use, the waterfowl classification appears at both the provincial and regional level. As with the Land Capability Classification for Recreation, this classification is an integral part of the Alberta Land Conservation Guidelines of the Land Surface Conservation and Reclamation Act.

> 6. (1) Where development land borders on or contains a waterbody, that is classified as having a waterfowl capability of Class 1, 2, 3 or 4, there shall be no development or disturbance unless a greater or lesser distance is prescribed in the applicable Regulated Surface Operations Regulations, or unless specific approval therefore is granted, of that part of the land that lies within (a) 100 feet of the waterbody, where the area of the whole waterbody is less than 10 acres, or (b) 200 feet of the waterbody, where the area of the whole waterbody is not less than 10 acres and not more than 40 acres, or (c) 300 feet of the waterbody, where the area of the whole waterbody is more than 40 acres.
>
> (2) Where development land borders on a waterbody or contains a waterbody that is classified as having a waterfowl capability of Class 5, 6 or 7, there shall be no development or disturbance unless a greater or lesser distance is prescribed in the Applicable Regulated Surface Operations Regulations, or unless specific approval therefore is granted, of that part of the land that lies within (a) 100 feet of the waterbody, where the area of the whole waterbody is 40 acres or more, or (b) such greater or lesser distance as the Approving Authority prescribes, in any other case.

> (3) This section does not apply where the outdoor recreation capability of the waterbody is Class 1, 2, 3 or 4.[150]

This section of the Land Conservation Guidelines has been adopted by the Peace River Regional Planning Commission in the designation of lakeshore corridors in Patterns for the Future, their Preliminary Regional Plan.

The Preliminary Regional Plan of the Battle River Regional Planning Commission has referenced the waterfowl classification by indicating that migratory staging areas should be protected through zoning. This protection is required to reduce the impact of human activity in these critical areas.

The provincial map of waterfowl capability has, as in the other classifications, combined the classes into several categories. The first category is composed of Classes 1S, 2S, 3S and 3M, the second Classes 1 and 2, the third Class 3, the fourth Class 4 and the fifth Classes 5, 6 and 7. As with wintering ranges in the ungulate classification this arrangement emphasizes the importance of migration stops.

7. Capability Classification of Fresh Waters for Sport Fish

The Capability Classification of Fresh Waters for Sport Fish has received less attention than any of the other classifications. It has received practically no public exposure and is referred to in only a few planning studies. This lack of use is obviously partly due to the fact that 1:250,000 map sheets were never printed. In Alberta 1:50,000 ozalid sheets are available from the Department of Energy and Natural Resources.

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[150] Alberta The Land Surface Conservation and Reclamation Act, Land Conservation Regulations, Schedule, Land Conservation Guidelines, Section 6, OC815/74.

(a) Utilization in Alberta

One of the few examples of the use of this classification by consultants is contained in the Environmental Study of the Cold Lake Area which was prepared for Imperial Oil in 1974. The lakes and rivers within the study area are evaluated according to the four class system.

The Calgary Regional Planning Commission's report Physical Characteristics - Calgary Region Growth Study is one of the few studies to illustrate the sport fish capability of the watersheds. Only one lake within the study area, Chestermere has been rated independently.

The atlas Historical and Physical Setting prepared for the Lesser Slave Lake Regional Plan includes the following description.

> There are two Class 1 waterbodies, Peerless Lake and Gods Lake, in the area. There are also numerous Class 2 lakes and streams which have minor limitations for sportfish production...Sportfish species such as Walleye, Arctic Grayling, Northern

> Pike and Lake Whitefish are found generally throughout the area. On the whole, the area has relatively high capability for sportfish production. Silting caused by erosion in the Swan Hills is detrimentally affecting these resources, particularly in Lesser Slave Lake, by covering spawning beds and damaging food supplies.[151]

The Peace River Regional Planning Commission in its Preliminary Regional Plan, Patterns for the Future has utilized the sport fish capability classification as a guide to land use within lakeshore corridors. The report indicates that the lakeshore corridor on waterbodies with a sportfish capability of 4 or better will be 100 feet on waterbodies less than 10 acres, 200 feet between 10 and 40 acres and 300 feet over 40 acres. "Where the land borders on a water body of whose shoreline has Canada Land Inventory waterfowl or sportfish capability of 5, 6 or 7 the Lakeshore Corridor shall comprise that part of the land which lies within 100 feet of the waterbody."[152] This last statement is rather misleading since the sportfish capability classification does not contain classes 5, 6 or 7.

As indicated previously, use of this classification is quite limited and it will certainly not received as much attention as the other classification.

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[151] Alberta Municipal Affairs, Planning Services Division, Regional Planning Section Historical and Physical Setting - Lesser Slave Lake Regional Plan, 1977, p. 26.

[152] Peace River Regional Planning Commission Patterns for the Future, 1976, p. 38.

In this chapter approximately sixty examples in which Canada Land Inventory classifications are used on an individual basis have been documented. The level of utilization varies considerably. Often it is simply descriptive and reference may be to a specific class rating within a classification. In other instances the seven class ratings and sub-classes have manipulated in the development of standards.

Use of the present land use classification has been primarily descriptive, and with the exception of the creation of acreage figures, little analysis has taken place. At the other extreme the soil capability classification for agriculture has received extensive analysis. Concerns across Canada over the loss of prime soils have prompted governments to place controls on land uses detrimental to agriculture. The C.L.I. soil capability classification has been used as the resource base to develop these controls, and noteworthy examples can be found in the Ontario Green Paper on Planning for Agriculture - Food Land Guidelines, the British Columbia Land Commission Act, the Recommendations of the Alberta Land Use Forum and in zoning bylaws prepared by Alberta Regional Planning Commissions.

The land capability classification for forestry has received minimal use. Due to the detailed structure and complexity of the classification, any analysis has been limited to forestry specialists.

The use of the land capability classification for recreation has been largely confined to its shoreline component. It has been used to identify prime beach areas, and both the classes and sub-classes have been used in the development of standards and regulations.

Uses of the remaining three capability classifications, ungulates, waterfowl and sport-fish have been primarily descriptive. The most important purpose of the ungulate classification has been in the identification of winter ranges while in waterfowl it has been migration stops. In a few instances the classifications have been incorporated into bylaws and regulations in an attempt to preserve critical habitats.

As has been shown in this chapter the classifications on an individual basis have utilized mainly for descriptive purposes and little manipulation of the classes and sub-classes has taken place. Attempts to incorporate the classifications into legislation are rare, but some examples, especially in the soil capability classification for agriculture, can be found.

CHAPTER VII

LAND CAPABILITY ANALYSIS

Although it is important to evaluate the utilization of individual classifications as shown in the last chapter, it is even more important to investigate those studies which are attempts to compare classifications or in which a number of classifications are combined in a decision-making process. It is in this latter type of analysis that the true value of the capability classifications can be evaluated.

Land use studies conducted to date that have utilized the Canada Land Inventory represent a major step forward in the techniques of land analysis. However, to fully capitalize on the information of the C.L.I. for regional planning it is necessary to devise a method by which the data can be utilized to allocate optimum land uses.

The temptation to make horizontal comparisons is heightened due to the design of the classifications. It would appear logical that a class 1 in recreation would be equivalent in value to a class 1 in the other classifications. However, this is certainly not the situation, and it would be difficult to argue that the renewable resource value of a class 1 upland recreation area is equivalent to a class 1 ungulate habitat area.

In other instances it has been assumed that two or more classes of a particular classification are equal in value, and this amalgamation of classes is then compared with other classifications.

A third technique and one that probably offers the greatest potential for land capability analysis is the establishment of priorities. It is this area of research and investigation that some of the most creative applications of the C.L.I. have been made.

In a number of land use studies several of the capability classifications have been used in developing a recommended or optimum land use map but no mention is made of how conflicts in resource capability were resolved. Obviously most land areas have potential for a number of renewable resource uses and in many instances the potential of two or more resources may be virtually equal. Some studies include attempts to solve this problem by protraying resource capabilities on separate maps. In many cases, however, various capabilities are compared through sieve mapping techniques, and some rationale is developed to dispose of conflicts.

1. Allocation Studies in Atlantic Canada

One of the first studies to investigate the relationship between capability classifications was the Mactaquac Regional Development Plan which was prepared for the New Brunswick ARDA Committee in 1965. In this study agriculture capability was mapped in three categories (a) class 2 and 3 (b) class 4 and (c) class 5, and forestry was mapped in two categories (a) class 2 and 3 and (b) class 4 to 7. A third map showed forest lands in terms of the maturity of the timber stands which included saplings, pole size and sawlog size.

These three maps were combined in an overlap process to produce a composite which provided a first approximation of a land use plan. In the Mactaquac study the overlay process was used to show areas which had potential for both agriculture and forestry. Conversely the procedure is often employed to show increasing degrees of constraint for a particular type of development.

The overlay method is a first step towards land allocation; however, a priority between uses is not established and the map is often difficult to interpret.

In 1971, a report entitled Landowners and Land Use in the Tantramar Area, New Brunswick was prepared jointly by the Canada Land Inventory of the Department of Regional Economic Expansion and the Policy Research and Co-ordination Branch of the Department of Energy, Mines and Resources. Included in the report is a chart showing acreages for the various C.L.I. classifications.

TABLE 58

CANADA LAND INVENTORY LAND CAPABILITY CLASSIFICATION
TANTRAMAR AREA, NEW BRUNSWICK

	Resource Sectors									
	Agriculture									
Capability Class	Total Area Acres	%	Cleared Land Acres	%	Forestry Acres	%	Recreation Acres	%	Waterfowl Acres	%
1	nil				nil		nil		nil	
2	nil				nil		nil		1,053	.09
3	40,052	35.3	21,847	70.4	nil		nil		14,796	13.0
4	22,169	19.5	5,022	16.2	34,201	30.1	2,522	2.2	42	0.1
5	41,387	36.5	3,359	10.8	42,442	37.4	5,066	4.5	10,704	9.4
6	nil		nil		7,447	6.6	88,637	78.1	78	0.1
7	6,123	5.4	665	2.1	26,877	23.[illegible]	14,742	13.0	84,294	74.3
0(organic)	1,236	1.1	144	0.5						
Water	2,531	2.2			2,531	2.2	2,531	2.2	2,531	2.2
TOTAL	113,498	100%	31,027	100%	113,498	100%	113,498	100%	113,498	100%

Source: Canada, Department of Regional Economic Expansion, Landowners and Land Use in the Tantramar Area, New Brunswick, 1971.

The importance of agriculture is stressed in the report as 35% of the area is Class 3. Lack of Classes 1 and 2 is not considered significant as Class 1 is not found in the Maritimes and Class 2 is primarily confined to Prince Edward Island. The chart shows that only approximately 50% of the Class 3 land and 23% of Class 4 land is under cultivation. This degree of under-utilization would tend to indicate that sufficient land exists for the expansion of agriculture in the region.

This is one of the first studies to produce an integrated capability map and was compiled using information from the C.L.I. present land use and capability maps. Land use zones were plotted as in the following sequence:

(a) Improved land with agricultural capability ratings of Class 3 or Class 4.

(b) Land with waterfowl capability ratings of Class 2 or Class 3.

(c) Forested land with a forestry capability rating of Class 4.

(d) Land with recreational capability ratings of Class 4 or Class 5.

(e) Forested land with agricultural capability ratings of Class 3.[153]

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[153] C. L. Jackson & J. W. Maxwell, Landowners and Land Use in the Tantramar Area, New Brunswick, Canada Land Inventory, Department of Regional Economic Expansion, C.L.I. Report No. 9, 1971 and Policy Research and Co-ordination Branch, Department of Energy and Natural Resources, Geographical Paper No. 47, 1971, p. 23.

These categories were over-lapped on the map to illustrate areas with high capability ratings for more than one classification, to indicate areas where more than one land use was possible and conversely to indicate areas where potential uses would be incompatible.

The study was also important in designating areas of Class 2 potential for waterfowl where it was possible to improve habitats in certain areas of idle agricultural lands which had been identified as having conflicting potentials.

Land allocation procedures based on the Canada Land Inventory were developed in the study Landowners and Land Use in the Musquodoboit Valley Nova Scotia published by Environment Canada in 1974. The report contains an integrated capability map which identifies areas of high capability for the various resource sectors of the C.L.I., and land was allocated according to the following sequence:

1. cleared land with agricultural capability ratings of Classes 2, 3 or 4.
2. land with wildlife (waterfowl) capability ratings of Classes 1, 2 or 3.
3. land with an outdoor recreation capability rating of class 3.

4. forested land with a capability rating of Class 3 or 4 for forestry.
5. forested land with agricultural capability ratings of Classes 2 and 3.[154]

Although a sequence or priority is indicated, the categories are not exclusive. Some areas overlap on the Integrated Capability Map, and in this manner areas of potential conflict for resource uses are illustrated.

The Integrated Land Capability data were combined with socio-economic information to develop an Indicative Land Use Plan which allocated land for agriculture, wildlife, integrated use: agriculture and wildlife, urban, recreation and conservation uses.

2. Allocation Studies in Ontario

In 1968 David R. Cressman prepared a report entitled *The Production Capacity of the Natural Resources of Manitoulin Island*. This study conducted at the request of the Ontario ARDA administration was intended to formulate a resource development strategy for Manitoulin Island. The examination of the productive capability of Manitoulin's natural resources focused on the capability of the land to support four major types of land use: agriculture, recreation, forestry and wildlife.

The study indicated that continuous cultivation of common field crops under good management practices could only be expected to yield a profitable return on investments over the long run on soil capability class 2 and 3 land. In any sector where large acreages of marginal and sub-marginal land were used for cultivated field crops the economic efficiency of both small and commercial farms would tend to be low. On Manitoulin Island about 1/3 of the cultivated acreage was situated on non-arable land in 1966.

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[154] Lands Directorate, Environment Canada, *Landowners and Land Use in the Musquodoboit Valley of Nova Scotia*, Geographical Paper, No. 55, 1974, p. 23.

The suggested land use map included at the end of the report provides the initial guidelines for establishing a land use policy; however, no attempt has been made to designate the types of operations best suited to each area. The author indicates that "a broad policy of land use, which designates areas and uses that will receive priority in development, must be established before land use planning can be carried out within the specific areas." [155]

The agricultural section of the suggested land use map is divided into three groupings: (A) grain, soil capability classes 2 and 3, (B) improved pasture and hay - class 4 and 5 and (C) unimproved pasture - class 6.

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[155] David R. Cressman, The Productive Capacity of the Natural Resource of Manitoulin Island, The Canada Land Inventory, 1968, p. 139.

In recreation the study indicates that areas of high shoreland capability for cottaging (mainly class 2 and 3) should be developed for cottage sites before areas of lower shoreland capability. This view is not held in many other studies which recommend that class 2 and 3 shorelands should be developed for intensive use activities while cottages would be confined to the lower capability classes - primarily classes 4 and 5.

Forestry and wildlife have been combined on the suggested land use map. The highest category, natural regeneration forest and upland wildlife, consists of areas of moderate forest capability (predominantly classes 5 and 6).

The study recommends that these areas should be fenced from use by cattle and managed for both forest and wildlife production. Large areas of class 7 agricultural land adjacent to, or surrounded by, unimproved pasture are also placed in this category. A second category consists of class 7 forest land which is suited to natural regeneration forest and wetland and upland wildlife. A third category is titled reforestration of farmland. It consists of small scattered parcels of farmland, presently in use or abandoned, with class 2 or 3 forest capability. The final category is indicated as Game Preserves and consists of two small areas with high capability for waterfowl. The suggested land use map has been divided into three broad land uses: agriculture, recreation and forestry-wildlife. Each of these uses has been further sub-divided based on the various capability classifications. Obviously conflicts exist between resource uses but no mention is made of how those were resolved. There is no problem in assessing recreation since only the shoreland units were included in the final land use map. However, the problem still exists as to the method used in resolving the conflict between agriculture and forestry. An assessment of the two capability maps involved and the suitability systems outlined in the agriculture and forestry sections revealed no definite patterns as to the creation of the suggested land use map. In reaching a final decision agriculture and forestry were certainly compared with each other but the technique is not indicated.

In 1970 the Regional Development Branch of the Ontario Department of Treasury and Economics prepared a report entitled The Land Capability Analysis Component of Ontario's Regional Development Plan. In 1966 the Government of Ontario had tabled its White Paper Design for Development which indicated the province's policy for a regional development program. A series of regional development plans were to be prepared and the analysis portion would examine the physical rural resource capability utilizing the Canada Land Inventory.

Two techniques were developed for analysis of the C.L.I. data, with the first being the sieve mapping procedure. The procedure was used in developing a Land Capability Analysis Map in which a number of development factors were superimposed. The capability classifications that were used included (a) agriculture classes 1 and 2 (b) agriculture class 1 and recreation classes 4 to 6, (c) agriculture classes 2 and 3 and recreation classes 4 to 6, (d) recreation classes 1 to 3, and (e) recreation classes 4 to 6.

Although a sieve mapping technique has been employed in producing the Land Capability Map, the disadvantages of the system are clearly indicated in the report.

> As the number of development factors increases, effective presentation tends to become a cartographic problem. With more than four development factors overlaid, it is difficult to read the significance of any one distribution vis a vis the other. It is impractical to read gradations of suitability for different land uses very precisely, let alone quantify the values discerned.[156]

Capability classifications were also compared in phase one of Design for Development: Midwestern Ontario Region. The Land Capability analysis map included in the report illustrates the resource potential of the region according to the following categories. (a) agriculture - classes 1 to 2 (b) agriculture - classes 1 to 3 and recreation - classes 4 to 6 (c) intensive recreation - classes 1 to 3 and (d) recreation - classes 4 to 6.

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[156] Ontario, Department of Treasury and Economics, Regional Development Branch, The Land Capability Analysis Component of Ontario's Regional Development Plans. 1970, p. 26.

The study indicates that "a high proportion of the Region, characterized by single predominant resource capabilities, presents limited potential conflict between competing land uses."[157]

This conflict is further reduced through the legend on the Land Capability Analysis map which has combined agriculture classes 1 to 3 and recreation classes 4 to 6 into one category. This technique of analysis may be suitable in relatively uniform settled areas as in midwestern Ontario but it certainly could not be used in areas with more complex land uses. Also because the map only shows two relatively unrelated capabilities - agriculture and recreation, the chance of conflict is reduced.

In Countryside Planning, A Pilot Study of Huron County prepared in 1976 the capability classifications have been used to develop a Potential Perspective Areas map. Areas without conflict and those with are designated, but specific capability classes are not indicated. Most of the County is shown as having potential for agriculture with no conflicting capabliity. Conflict areas between agriculture and recreation and between agriculture, recreation and environment lands are indicated by numbers on the map. The map is useful in that it provides a clear indication of non-conflict lands that have potential for agriculture; however, the areas designated as having conflict are not very meaningful as the degree of conflict is not indicated. This could have been easily resolved by showing the capability classes for agriculture and recreation.

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[157] Ontario, Department of Treasury and Economics, Design for Development: Midwestern Ontario Region, Phase One: Analysis, 1970, p. 108.

3. Allocation Studies in Manitoba

Another early attempt to use the capability classification was made in the Shellmouth Designated Reservoir Area Proposed Land Use Plan prepared in 1969 by the Manitoba Department of Mines and Natural Resources. The objective of the report was "to determine the capability of the Shellmouth Designated Reservoir Area for agriculture, recreation, fish and wildlife, and to prepare a land use plan that will guide orderly development of the...Area in the best interests of conservation." [158]

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[158] Manitoba Department of Mines and Natural Resources, Shellmouth Designated Reservoir Area Proposed Land Use Plan, Winnipeg, 1969, p. 25.

The study indicates that class 2 and 3 lands are suited to intensive cultivation, class 4 limited crop production but highly suited to forage production, class 5 production of forage or limited nature grazing and class 6 not suited for agriculture.

The recreation component of the plan was not based on the C.L.I. because the reservoir had not been filled with water at the time of investigation and hence, there was no shoreline.

In addition to agriculture the study contains descriptions of the capability of lands in the reservoir area for the production of white-tailed deer. Lands designated class 1W, 2 and 3 were to be preserved from all uses other than hunting, fishing, hiking and nature study. Lands designated class 2W and 3W were to be used only for extensive recreation.

The methodology involved in this study closely resembles that of the Manitoulin Island plan. The various capabilities were analyzed in isolation and then combined in the formulation of the plan. The recommended land uses based on the two capabilities classifications used, agriculture and ungulates, as well as those areas recommended for recreation, overlap but no mention is made of how conflicts were resolved.

4. Allocation Studies in Alberta

In Alberta a major user of the sieve mapping technique has been the Red Deer Regional Planning Commission. Such a system is described in their study Physical Environment Inventory. A regional resource capability sieve map was prepared by combining the capability maps together in a manner which provided an indication of the best potential use of the land. A priority method of analysis for the allocation of resource capabilities was developed and land areas were assigned to a single prime land use. This system based on research conducted by Alberta Municipal Affairs will be discussed in detail in chapter IX, section 4 of this thesis.

In the Country Residential Development Study prepared by Alberta Municipal Affairs in 1974 for the Hinton-Yellowhead Corridor an overlay process has been utilized to identify areas suitable for country residences. In order to select sites, areas with physical limitations to development were sifted out using a series of map overlays. These limitations were obtained from the C.L.I. capability maps with the following classes being considered as not suitable for development:

(a) Ungulate Winter Ranges - conflict with residential development.

(b) Waterfowl Production Areas - classes 4 and 5. The study area is almost completely void of waterfowl sites and the few class 4 and 5 that do exist are considered worthy of preservation. As well as being ecologically unique these waterfowl production sites are primarily temporary ponds or marshes and pose drainage problems to country residential development.

(c) Recreation Areas - class 2, 3 and 4 are restricted from development.

(d) Forestry - class 4 - the highest class within the area is restricted from development.

(e) Agriculture - Class 4 - one of the major problems with country residential development has been the removal from production of large tracts of arable land. Class 4 is the highest in the area and is restricted from country residential development.[159]

These C.L.I. capability ratings along with a number of other physical limitations were presented in a variety of colours on clear overlays to indicate areas that were not considered suitable for country residential development. The remaining areas were further analyzed regarding the availability of roads, school bus routes, telephone, power and natural gas before a final selection of sites suitable for development was made.

Although the visual techniques used in the study are quite effective, they do have their limitations. Overlay or sieve mapping techniques are fine for small areas but become unmanageable for large areas. The same is true for the cost of printing the overlays.

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[159] Alberta Municipal Affairs, Country Residential Development Study, The Hinton-Yellowhead Corridor, Research Planning Section, 1974, pp. 40-44.

Many studies which have used the sieve technique include only the final composite map. One of the important components of the Hinton-Yellowhead Study is that each constraint to development is displayed on a separate overlay, and it is possible to view their relationships.

In 1975 the Lands Directorate of Environment Canada prepared a 1:1,000,000 scale map entitled Alberta Critical Capability Areas.

> The purpose of this map is to highlight the areas that have a high capability for one or more resource uses. These key capability areas have been designated as being critical in that they represent the lands that are the most productive, or the best suited to a range of uses, or that are essential for the maintenance and production of wildlife.[160]

The map is divided into the following categories:

1. Agriculture - class 1 to 3
2. Forestry - class 3
3. Recreation - class 1 to 3
4. Ungulates - class 1, 2, 1W, 2W and 3W
5. Waterfowl - class 1, 2, 1S, 2S and 3S
6. Combinations - areas where any two of the above classes overlap
7. Combinations - areas where three or more classes overlap
8. Not classified - classes 4 to 7 in Agriculture, Forestry and Recreation and classes 3 to 7 for Ungulates and Waterfowl

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[160] Canada, Environment, Lands Directorate, C.L.I. Alberta: Critical Capability Areas, map. 1975.

These categories, however, suffer from some of the constraints identified in earlier studies and can be easily misinterpreted. The combination of capability classes within classifications makes inter-classification comparisons difficult. Much of the land east and south of Edmonton is shown as being critical for both Agriculture and Ungulates but the exact class is not given.

The problem with these types of generalizations are clearly illustrated on this map. For those not familiar with Alberta or the Canada Land Inventory this map presents an unrealistic portrait of the province's renewable resource potential. It is difficult at times to separate existing land use from potential or capability and if the map was viewed in terms of existing land uses it would be very misleading. Even in terms of capability the map is misleading due to the choice of capability classes used in the categories. The map gives the impression that Alberta has very little potential for forestry as only class 3 areas are shown and they are very limited in the province. Vast areas of Alberta are covered with class 4 and 5 forests and are the basis for much of the $120 million forest industry (Alberta Department of Business Development and Tourism 1977) but on the map these areas are not indicated as being of prime importance.

The dominance of the shoreline component of the recreation classification over the upland component is evident. The Eastern Slopes of the Rocky Mountains are shown as having low potential for all resource uses with the exception of ungulates. The Government of Alberta hopes to establish a viable recreation and tourist industry in this area, yet the map suggests that the potential is low. An examination of more detailed 1:250,000 and 1:50,000 maps shows that the Eastern Slopes contain large areas of class 4 recreation land.

The importance of prime agricultural land is diminished in the east central part of the province by its combination with ungulates and waterfowl. Prime agricultural areas on the map are shown in orange while the combination areas are shown in purple. It is extremely difficult to illustrate the importance of both agriculture and wildlife by this method and they both suffer as a result.

One of the major criticisms of the Canada Land Inventory has been lack of detail, and the further generalization from a 1:50,000 working map scale to this 1:1,000,000 map certainly does not help to rectify this problem.

5. Lakeshore Potential and Allocation Studies in Alberta

The Red Deer Regional Planning Commission in analyzing the potential of lakeshores has utilized a number of capability classifications to develop a regional lake classification system. The first step in this analysis was an inventory of the length of shoreline in each of the capability classes around the Commission's 123 study lakes.

The investigation indicated that 166 km. (104 mi.) (13%) of the Commission's 1256 km. (785 mi.) of shoreline had recreation capability classes of 1, 2 or 3 and these were restricted to 23 (19%) of the 123 lakes. Class 1 accounted for 1.8 km. (1.1 mi.) (0.1%) and class 2, 26.2 km. (16.4 mi.) (2.1%). In the waterfowl classification 405 km. (253 mi.) (32%) was class 1 and 2, in ungulates 434 km. (271 mi.) (35%) class 1 and 2, in agriculture 86 km. (54 mi.) (8%) class 1 and 2, in forestry 32.6 km. (20.4 mi.) (14%) class 4 and in sportfish 50 km. (31 mi.) (4%) class 1.

The lake inventory also indicates acreage figures for capability classes within 1.6 km. (1 mi.) of the shoreline. However, the importance of this information is questionable and the purpose for including it in the report is unclear. In the case of recreation it is rather misleading, for shoreline units are usually less than .8 km. (1/2 mi.) in width, and the capabilities behind these units are not related to the capabilities of the shoreline.

The Lake Classification developed by the Red Deer Regional Planning Commission was first presented in Regional Lake Perspective - Red Deer Area which was prepared by the Commission in July 1974. Later that year virtually the same report entitled "The Framework Approach -

Towards an Integration of the Regional, Management and Operational Perspective - The Red Deer Region" was included in the Alberta Land Use Forum's Technical Report #12 Use of Our Lakes and Lake Shore Lands. After refinement of the methodology, Regional Lake Perspective: Inventory and Policy Directions was published in April 1976.

The purpose of the Red Deer study has been indicated as follows:

> A fundamental objective of this study is to identify the function of each lake within the regional lake system. This recognizes that each lake, based upon its own natural qualities, resource capabilities and surrounding land uses and ownership patterns, has a role to play within the regional lake system.[161]

The system developed by the Commission is based on three classes of lakes: scenic, wilderness and development. These in turn, except for wilderness, are divided into three sub-categories: provincial, regional and local. The scenic lake classification promotes the conservation of resources while allowing non-intensive recreational activities.

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[161] Red Deer Regional Planning Commission, Regional Lake Perspective: Inventory and Policy Directions, 1976, p. 35.

The following criteria was used in determining scenic lakes.

TABLE 59

SCENIC CLASSIFICATION
RED DEER REGIONAL PLANNING COMMISSION

Status	Resource	C.L.I. Rating
Provincial Scenic		
any one of	waterfowl	1S, 2S, 3S, 3M
	ungulate	1W
	sport fish	1
	recreation	any class
Regional Scenic		
any one of	waterfowl	1
	ungulate	2W, 3W
	sport fish	2
	recreation must be	4
Local Scenic		
any one of	waterfowl	2, 3, 4, 5, 6, 7
	ungulate	1, 2, 3, 4, 5, 6, 7
	sport fish	3, 4
	recreation	5, 6, 7

Source: Red Deer Regional Planning Commission, Regional Lake Perspective: Inventory and Policy Directions, 1976

The second class of lake is that of wilderness, and this category includes all the lakes within the Siffleur and White Goat Wilderness areas. Similar quality lakes in the same general area were also given a wilderness status, and all wilderness lakes were assigned a provincial level of importance.

The third level of classification is development, and lakes are divided into the following three categories: Provincial-recreation capability 1, 2, 3, Regional class 4, and Local classes 5, 6, and 7. The rationale for this development classification is indicated as follows:

> In reaction to development needs certain lakes not otherwise designated as wilderness lakes were withdrawn from scenic status and designated as developable lakes. These water bodies already support some development or were felt capable of doing so because of the recreation capability, land use and ownership patterns around them.[162]

All lakes are initially designated to a scenic status of provincial, regional or local, then certain lakes are designated as wilderness and finally lakes offering development potential are assigned to that category. This system of classification, developed by the Commission, has been based upon the supply and quality of lakes with the region and the various demands for their use. The classification provides the framework for more detailed management studies.

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[162] *Ibid*., p. 36.

Since the development of this classification by the Red Deer Regional Planning Commission several other Commissions have adopted it. The Edmonton Regional Planning Commission like Red Deer prepared a series of sieve maps which showed C.L.I. capability classes within .8 km. (1 mi.) of the shoreline of each lake.

> The object of this exercise was to build up a comprehensive regional perspective of the natural resource capabilities of lakes in the Edmonton Region and determine the location of prime recreation, agricultural and conservation areas as they relate to regional water bodies. Similarly, conflicts in the potential use of a given lake shoreland could be determined. [163]

The Edmonton study, as with Red Deer, compiled acreage and shoreline lengths for each class in the capability classifications within one mile of the shoreline. In addition the Edmonton Regional Planning Commission adopted the lake classification system developed by the Red Deer Regional Planning Commission. Lakes were identified as having potential for conservation (scenic) or development. None of these lakes within the study area were classed as wilderness. In total 125 lakes were classified.

In the allocation of lakes to either a conservation or development category the following criteria were used:

1. Initially all lakes were assigned a conservation and/or development value.

2. The lake was assigned to the category of the higher value. (regional conservation higher value than local development).

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[163] Edmonton Regional Planning Commission, Regional Lake Perspective, 1974, p. 21

> 3. If lakes were the same value those within 60 minutes driving time from Edmonton were assigned to development category.
>
> 4. Lakes with questionable value assignment were re-examined relative to the following parameters.
>
> Lakes with existing recreational or resort development were assigned a development value. Lakes with shoreline of class 1 - 3 soil capability, and with no recreational development were assigned a conservation value.[164]

Although this classification has merit it does present some problems. The length of shoreline in a particular class is not reflected in the classification. A lake with 8 km. (5 miles) of recreation class 4 shoreline (which is ideally suited for cottages) and 152 m. (500 feet) of waterfowl class 3S (migration stop) would be classified provincial conservation, thus eliminating the lake's use for cottages. A lake with 1.6 km. (1 mi.) of recreation class 1 beach and 152 m. (500 feet) of waterfowl class 3S and further than 60 minutes driving time from Edmonton would be classified provincial conservation. A lake with 46 m. (150 feet) of recreation class 3 shoreline and 4.8 km. (3 mi.) of waterfowl class 1S and within 60 minutes driving time from Edmonton would be classified as provincial development.

The classification provides an initial view of the potential of lakes for development or conservation. However, variations in lakes and shorelines makes it difficult to apply on a consistent basis. Further research and study will be required to fully develop the classification.

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[164] _Ibid._, pp. 27-29

The Oldman River Regional Planning Commission also adopted the system developed by the Red Deer Regional Planning Commission in the classification of its 35 lakes. The criteria for classification were the same except for lakes that were classified equally for conservation and development purposes were assigned to conservation if the agricultural capability of the shoreland was class 1, 2, 3 or 4.

The individual C.L.I. capability classifications have been used in a general sense in determining the potential of Alberta's lakes. The procedure is described in Technical Report No. 12, Use of Our Lakes and Lake Shorelands, prepared by the Alberta Land Use Forum. The ratings or classes were divided into categories as indicated in table 60.

Although the rationale for the division of these ratings into the four categories is not indicated, it basically assumes that the individual classes are equal throughout the classifications. (A class 1 in recreation is equal to a class 1 in agriculture).

Six hundred and thirty lakes had previously been identified by Alberta Environment in the Province and these were classified according to the criteria established in table 61.

TABLE 60

C.L.I. RATINGS USED TO DETERMINE POTENTIAL OF ALBERTA LAKES

C.L.I.	Excellent	Good	Moderate	Low
Agriculture	1, 2	3, 4	5, 6	7
Recreation	1, 2	3, 4	5	6, 7
Ungulates	1W, 1 2W, 2	3, 3W	4, 5	6, 7
Waterfowl	1S, 1 2S, 2	3S, 3 3M	4, 5	6, 7
Sport Fish	1	2	3	4
Forestry	1, 2, 3	4	5	6, 7

Source: Alberta Land Use Forum - Use of Our Lakes and Lake Shorelands, 1974.

TABLE 61

ALBERTA LAKE POTENTIAL

Inventory	Excellent	Good	Moderate	Low	No Data
Agriculture	73	145	86	20	306
Recreation	58	211	167	53	141
Ungulates	126	109	234	13	148
Waterfowl	132	85	213	91	109
Sport Fish	6	61	73	131	359
Forestry	18	142	12	13	445

Source: Alberta Land Use Forum, Use of Our Lakes and Lake Shorelands, 1974.

The lakes have been assigned to the various categories for each of the classifications based on the best capability found on the shoreline of the lakes. Length of the dominant class was not considered in the assignments, and this of course minimizes the importance of the information. Many would say that it is at this level of detail that the capability classifications should be used. However, the importance of rating shorelands for agriculture and forestry is questionable. The most significant categories are recreation, waterfowl, and sportfish.

Most of the studies described in this section of the report have utilized a sieve mapping procedure in the analysis of land capability information. This technique has been employed to show both constraints to and attributes for development. Conflicting or overlapping capabilities are clearly illustrated by the technique.

6. Land Capability Analysis in British Columbia

In 1969 the British Columbia sector of the Canada Land Inventory developed a unique system for land capability analysis. The first study to be completed was the Land Capability Analysis of the Prince George Special Sales Area which attempted to indicate the highest and best use for a particular area of the Province using information from the C.L.I.

The land capability analysis map was compiled by means of an overlay process involving prime areas for the five capability sectors. The areas included in classes 1 to 3 in each capability sector were considered as being prime areas. They were indicated on the map except where two or more were superimposed. Where no higher capability was apparent from the first overlay, class 4 areas for both agriculture and forestry were added. Then perennial forage, class 5 agriculture, was added and the remaining areas were classed as low potential. Finally each conflict between prime capabilities, and between class 4 for agriculture and forestry was resolved by a special Land Capability Analysis Committee established for the study area. In resolving conflicts, consideration was not given to provincial or regional demands nor to socio-economic factors, but conclusions were based solely upon ecological criteria.

The text accompanying the land capability analysis of the Prince George Special Sales Area contains the following descriptions of the various resource uses shown on the map.

> Agriculture and Forestry - There is very little conflict betwen prime areas for agriculture and forestry. The small areas of prime agricultural soils are predominantly class 3 valley bottom soils. Where there was a conflict between the two sectors, the decision as to the sector to which the area was allotted was based on size of area, proximity to other good lands of the same sector and proximity of markets. If the uses remained in conflict after the three factors were considered, the area was allocated to the agriculture sector. The gross return from land use appears to be greater in agriculture than in forestry.
>
> Recreation - Recreation capabilities of the area are lower than those of many areas in the province. But most of the regions suitable for recreational pursuits are in the day-use or weekend range from the main population centres. Recreational use need not be exclusive of other land uses, but require that forest practices along shorelines and access roads be carried out so that outdoor recreation values receive prime consideration.

> Ungulates - Moderately high capability ungulate range is widely available, covering a third of the analysis area, with moose being the main species. Forestry and wildlife are generally compatible, and in most cases the areas of high capability for both sectors have been given the forestry rating on the map. Many of the recreational areas are also prime ungulate areas, but in the analysis area the two uses are compatible.
>
> Waterfowl - Only one small high capability waterfowl area occurs. There are no conflicting uses.
>
> Low Potential Areas - Low potential areas are those in which capabilities for all sectors are low. Because of the low capability, no single use is recommended.[165]

More specifically, the capability classes have been used to develop the legend for the capability analysis map. Agriculture contains three categories: arable - classes 1 - 3, limited arable - class 4, perennial forage - class 5. The remaining categories on the map include: forestry - classes 1 - 3, forestry class 4, recreation - classes 1-3, ungulates - classes 1 - 3, waterfowl - classes 1 - 3, and low potential which consists of land rated lower than those categories which have been previously shown.

It is indicated on the map that the type of analysis used is only a guide to land use planning, and this fact is extremely important to remember when evaluating the generalized categories.

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[165] British Columbia, ARDA Committee Canada Land Inventory, Land Capability Analysis of the Prince George Special Sales Area, 1969.

In fact the grouping of classes 1 to 3 in the prime use categories defeats the original purpose of C.L.I. in developing seven classes. Significant variations exist in all capability sectors between classes 1 and 3. The management committee who created the map will know which areas are class 1, 2 or 3, but the user will probably not know and this could lead to development or zoning problems. The economic value of class 1 lands in all classifications is much larger than that of class 3 lands.

In the text it is stressed that the analysis is preliminary and lacks socio-economic data. However, once such a map is published the uninformed will ignore the small print and make land use decisions based solely upon the coloured land use zones on the map.

The land capability map developed for the Prince George Special Sales Area was an unique attempt in developing a methodology for the utilization of the C.L.I. Although it had many shortcomings, it was significantly better than any previous attempts at land capability analysis. The experience gained in the project has led to improved techniques, and subsequent land capability analysis maps have been prepared for several other regions in British Columbia.

7. Land Capability Zoning in Quebec

Similar maps have also been prepared in the Gaspe and Outaouais regions of Quebec. The analysis prepared for the Outaouais region closely resembles the procedure developed in British Columbia.

> The integrated map presents in a single document the most useful information for regional planning, but does not replace the original C.L.I. manuscripts. Based on a comparison of data concerning the physical attributes of land, the integrated map is not a plan for future land use. It should be considered as a guide to the capability of the land as indicated by the biophysical data. The land capability zoning map is the first stage in the process of regional planning and development.[166]

The methodology developed for the allocation of land to renewable resource uses involved three stages. The first stage isolated the best zones in each sector as shown in the following table.

TABLE 62

LAND ALLOCATION - OUTAOUAIS REGION - QUEBEC

Sector	Category A	Category B	Category C	Classes Not Retained
Agriculture	1, 2, 3	4	5	6, 7
Forestry	1, 2, 3	4	5	6, 7
Recreation	1, 2	3	4	5, 6, 7
Ungulates			2W, 3W	
Waterfowl			1, 2, 3, 4, 3M	

Source: Canada, Department of the Environment, Canada Land Inventory, Land Capability Analysis, Outaouais Region, Quebec

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[166] Canada, Department of the Environment, Canada Land Inventory, Land Capability Analysis, Outaouais Region, Quebec, 1972.

A second step was required in the allocation of land to agriculture with land use and agriculture capability maps being compared. Class 1, 2 and 3 lands regardless of use were assigned to agriculture. Class 4 and 5 lands under cultivation were also assigned to agriculture. Abandoned agricultural lands in classes 1 to 5 were designated with the letter X to indicate that further evaluation would be required before a final allocation could be made.

The third step involved the mapping of the zones in the following sequence.

1. urban zones
2. recreation zones
3. agricultural zones
4. forestry zones - transcribed in areas of the map not already allocated
5. ungulate wintering areas were indicated in forestry zones
6. waterfowl areas
7. low potential - areas not previously assigned

The legend of the zoning map contains the following explanation of the zoning methodology.

> The resulting zoning map is based primarily on capability, but it is not the result of a single comparison that attributes land to the sector with the highest classification. The criteria of

> evaluation for the different sectors have little in common; each sector has its proper methods and requirements. For example, the normal economic return from a zone of given forestry potential is not the same as that from an agricultural zone of the same class. The order of priority adopted for the zoning was based on three major trends observed in the evolution of land use. These trends are as follows: if space is necessary for outdoor recreation, agriculture and forestry will yield, forestry reoccupies only those agricultural zones already abandoned or in the process of being abandoned.[167]

The portion of the preceding quotation 'the criteria of evaluation for the different sectors have little in common; each sector has its proper methods and requirements. For example, the normal economic return from a zone of given forestry potential is not the same as that from an agricultural zone of the same class', is rather interesting for it is one of the few examples that can be found which indicates that horizontal class comparisons within the capability classifications cannot be made. A class 1 in agriculture is not equal to a class 1 in forestry. Many ARDA reports have indicated that the C.L.I. was designed for regional planning and if this is true, then obviously one would have to compare the classifications. The very nature of the 7 class structure of each classification would lead one to believe that such comparisons are valid and no ARDA reports have been published to indicate that this is not true. This is a point which has led to considerable confusion over the use of the C.L.I., and it is unfortunate that some of the ARDA - C.L.I. reports have not clarified this matter.

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[167] _Ibid._

The above statement which has been quoted from the Outaouais study places the C.L.I. classification system under suspicion, and although many would agree that it is true, the lack of explanation regarding horizontal comparison makes all comparisons questionable.

The methodology utilized in the study has shown some improvement over that in the Prince George Special Area Analysis. In the Outaouais study allocation has been based on priority, and in this manner conflicts have been avoided. Land is allocated in a consistent manner. In the Prince George study conflicts (equal capabilities) are resolved through committee, and such a system cannot be consistent.

As in the Prince George study the classifications are also grouped. Thus, through allocation a class 3 area for agriculture could have priority over a class 1 forestry area. The allocation system also appears to be biased in favour of recreation, for a class 4 area in recreation has priority over class 1 areas in the other classifications. This might be logical in an urban fringe area with large recreational demands, but it does not appear to be so in this study area.

In this chapter some of the land capability analysis techniques developed in the utilization of the Canada Land Inventory have been discussed. These techniques are important for they provide a means for incorporating renewable resource data into a regional planning process.

Many of the studies described in the chapter appear to have their capability analysis components based on the allocation methodology developed by Ian L. McHarg and described in Design with Nature, 1969. In his text McHarg describes how the various elements of the natural landscape can be identified and mapped through overlay procedures to develop an Alternative Suitabilities map. The procedures used in the identification of renewable and non-renewable resource potential are similar to those used in the C.L.I. capability classifications. The agricultural suitability map has been divided into five categories, and the forestry map four levels. The alternative suitability categories identified for the Potomac River Basin study, described in Design with Nature, are indicated in table 63.

These categories contain numerous conflicting land uses, and as an aid to determining final land allocation McHarg has developed an intercompability matrix. Final land allocations, however, are not indicated in the Potomac study.

McHarg has also employed the same methodology in the metropolitan region of Washington, D.C. to identify areas suitable for urban expansion.

TABLE 63

SYNTHESIS: ALTERNATIVE SUITABILITIES - POTOMAC RIVER BASIN

1. Prime Urban, Commercial Forestry (softwood),Recreation
2. Prime Urban, Commercial Forestry, Recreation
3. Prime Urban, Forest for Water Management, Recreation
4. Secondary Urban, Agriculture, Commercial Forestry, Recreation
5. Agriculture, Recreation
6. Agriculture, Commercial Forestry, Recreation
7. Commercial Forestry (softwood) Recreation
8. Commercial Forestry, Recreation
9. Forest for Water Management, Recreation
10. Prime Recreation
11. Prime Recreation, Oyster Beds
12. Prime Recreation, Forest for Water Management
13. Prime Recreation, Commercial Forestry
14. Prime Recreation, Commercial Forestry, Agriculture
15. Coal Mining, Recreation, Forest for Water Management
16. Coal Mining, Recreation, Commercial Forestry

Source: Ian L. McHarg, Design with Nature, 1969

The work of McHarg has had an obvious effect on the sieve mapping (overlay) techniques and allocation categories used in the studies outlined in this chapter. These techniques however have a number of limitations with a primary one being the ability to manipulate substantial amounts of data for large areas.

CHAPTER VIII

THE DEVELOPMENT OF COMPUTER RETRIEVAL SYSTEMS

The manual sieve mapping technique used in evaluating the capability classes proved to be ineffective in dealing with large areas and where a number of comparisons were required. As a result research was conducted in several provinces in the 1960's in an attempt to develop computer retrieval systems that would handle the large amounts of data created from the Canada Land Inventory. "A critical part of the C.L.I. program is the development of a system permitting concise and compact data storage allowing comparisons within, and between, sectors, output analyses in map or statistical form, and comparison of data for given regions and correlation of socio-economic or other data on selected areas." [168]

1. The Canadian Geographic Information System (CGIS)

To accomplish this task, research on a geographic information system was initiated under the C.L.I. program in 1963. The system was to be designed so that it could perform any analysis that could be achieved manually from the capability maps. Information from the

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[168] Canada, Department of Regional Economic Expansion, The Canada Land Inventory, Objectives, Scope and Organization Report No. 1, 1970, p. 15.

C.L.I. maps including boundaries and ratings would be read into the computer through a drum scanner which digitized the boundary lines and compiled area descriptions.

Initially information was placed in the system at a scale of 1:50,000. However, the many problems and delays encountered with the operational aspects of the system coupled with the vast numbers of map sheets required for input forced the Canada Land Inventory to change to the 1:250,000 scale of map in 1971. This step of course led to an even greater generalization of the original data. Resource personnel had complained about the lack of detail on the 1:50,000 manuscripts and now the 1:250,000 sheets were to be used for computer input. Many of the small areas on the 1:50,000 maps were combined to form larger areas so that they could be mapped at a scale of 1:250,000. These small and perhaps quite significant areas were thus lost through this transfer. When the 1:250,000 maps were produced from the 1:50,000 field sheets it was understood that the latter would be used for computer input. This change led to increased suspicion on the reliability of the system.

The system has taken approximately 15 years to develop to the point where it can now be utilized by provincial agencies. During these years many problems were encountered. In 1970 the system was experiencing a failure rate of 16 percent in the rejection of maps.

Another major problem was the appearance of 'woolly edgeless faces'.

> These areas are the result of using no common base when overlaying four independent overlays of the same piece of ground and obtaining four different representations. The resulting map depicts very narrow irregular areas lying so close together that the whole series of such units appear as a woolly complex. It is not certain whether these individual areas should function as boundaries between units or if each is a technicians representation of the same topographic feature. It depends on which of these explanations is the case, whether the units so defined are actual distinct areas or non-existent features developed as a result of drafting inconsistencies. By using the computer to analyze the map units it is not possible to know when a small real unit exists and when a non-existent unit is produced. As a result the type of area was defined as a 'no man's land'. [169]

Some of the Sector managers who reviewed this problem felt the information system was reaching a level of precision and accuracy which was not warranted because the input was generalized. "This might be described as a very accurate reproduction of imprecise information." [170]

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[169] Alberta, Government, Land Use Planning Technical Co-ordinating Committee, Minutes, March 8, 1971, p. 2.

[170] *Ibid*., p. 2.

Most of the problems associated with the development of the retrieval system have been resolved and it is now available for use by the Provinces.

An on-line computer graphics system has evolved as a major component of the Canadian Geographic Information System.

> The CGIS retrieval sub-system is the most important part of the CGIS from the users viewpoint because it is the means by which the data are retrieved for the user. User requests define the geographic areas about which the user requires information in the coverage or coverages to be analyzed. This unit can be defined in many ways, as for example:
>
> - a circle with Camrose as its centre and a radius of three miles;
> - a map upon which the user has drawn boundaries;
> - an area of any shape or size;
> - a single point or series of points;
> - any arbitrary figure (circles, polygons, grid systems etc.) [171]

The ability to have the C.L.I. data superimposed and dissolved is built into the graphics system. The various classifications can be superimposed one upon the other through use of a television monitor and boundaries can be removed as required through the dissolve process. Output includes both map and tabular format. Area measurement of the spatial units can be generated in acres, square miles, kilometres, etc. The system at present cannot provide data on a quarter-section basis or even at a township and range level.

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[171] Alberta, Environment, Environmental Co-ordination Service, Canada Land Inventory on Computer, Proceedings of a User Study, 1976, p. 2 - 3.

Although the system is rather sophisticated and offers considerable potential in resource analysis it has received little use outside of Ottawa. Most of the field work associated with the classifications was completed in the late 1960's, and those involved with the many components of the C.L.I. did not have the CGIS available to them for research purposes. Most of these people are no longer involved in C.L.I. programs and their expertise is thus lost. The success of the Canadian Geographic Information System must depend on a new generation of researchers who lack knowledge of the research and classifications conducted in the earlier years. The system has just taken too long to develop.

The complexity of the system has also lead to a consequential lack of use.

> The most significant implication is that although the retrieval sub-system is powerful and has been designed to meet almost any conceivable user need, it cannot be accessed easily by users. In fact, the retrieval sub-system is almost completely inaccessible to the casual user. Few potential users actually make requests because they do not know that the system exists or they are not prepared to assume the burden of learning all about the system before they can use it. [172]

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[172] Alberta, Environment, Environmental Co-ordination Service, Canada Land Inventory on Computer, Proceedings of a User Study, 1976, p. 4.

In an attempt to overcome this problem, the user oriented accessing package GRAPHICS was developed. This has helped Provincial researchers in accessing the system, but because of their overall lack of knowledge of the Canada Land Inventory it has become little more than a research tool.

In a 1975 workshop held in Edmonton to discuss the system the problem of adapting a generalized resource base inventory to a sophisticated and precise computer system was discussed. The future success of the system would be based upon its ability to include other types of land related data.

> By limiting the present data base creation to C.L.I. data, the utility of CGIS is significantly constrained. Because of this weakness, the workshop participants indicated a keen interest in the means by which other land related data could be entered into the CGIS system.[173]

It is unfortunate that the Canadian Geographic Information System took 15 years to develop. However, it is also unfortunate that the C.L.I. classifications were rushed to completion in under 5 years. A longer evolution would certainly have resulted in much more accurate data. The CGIS will undoubtedly be a forerunner of more advanced systems.

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[173] *Ibid.*, p. 9 - 10.

> The Canada Geographic Information System, a method of handling information for land resource analysis, will be extensively tested by the U.S. Geological Survey. The U.S. Geological Survey will soon be involved in a nation wide program of land use analysis in the United States. It has been seeking a computer-assisted method of processing and updating its land use information.[174]

Few examples exist on the use of the Canadian Geographic Information System in Land Capability Analysis. However, in two studies sponsored by the Lands Directorate attempts have been made in this regard.

In 1976 the Lands Directorate of Environment Canada published a report entitled Rural Land Use Changes in the Ottawa-Hull Urban Region. This report is one of the few published examples of the use of the Canada Geographic Information System (C.G.I.S.). Its purpose was to measure changes in land use in the Ottawa area through the use of on-line interactive graphics. The system was used to compare land use from 1964, 1968 and 1973 with agriculture and recreation capabilities.

The Canadian Geographic Information System provided acreage figures for the agricultural capability classes, the primary and secondary limitations, present land use categories, and the recreation classification with its primary features. The acreage figures for limitations and features were not aggregated according to class.

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[174] Canada, Environment, Lands Directorate, News Release, Environment Canada Computer System to be used by U.S. Government Agency, 1975.

The study stresses the importance of (C.G.I.S.) in measuring changes in land use.

> It is the area of land use dynamics that the overlaying ability of the Canada Geographic Information System (C.G.L.S.) demonstrates its strong points. Not only does it provide a measure of the type and amount of land in a particular use, but it gives the location of this land on a map and shows how the land has changed.[175]

The study points out some interesting phenomena in the change of rural land to urban uses. Comparison of present land figures indicates that improved agricultural land has a tendency to be converted to idle grassland before it is subdivided for urban purposes, and urban expansion utilized the better quality agricultural lands. In addition, it is indicated that there is a very low correlation between recreation capability and land which is actually developed for recreation. In total the report contains 76 tables which illustrate relationships between the classifications indicated above. Some of the more important results are indicated in table 64.

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[175] Environment Canada, Lands Directorate Rural Land Use Changes in the Ottawa-Hull Urban Region by D. M. Gierman, Occasional Paper No. 9, 1976, p. 26.

TABLE 64

RATE OF URBANIZATION

	1964-68 Acres/Year	1969-73 Acres/Year	Change in the Rate of Change %
All land uses	1,213	2,537	+ 109
Improved Agriculture (H,G,A,P)	582	998	+ 71
Unimproved Pasture & Idle Grassland (K)	392	835	+ 113
Forest (U,T)	183	549	+ 200
Agricultural Capability (1,2,3)	809	1,331	+ 65

Source: Environment Canada, Lands Directorate, Rural Land Use Changes in the Ottawa-Hull Urban Region, 1976

The relationship between capability ratings and physical variables of the environment are investigated in a report entitled The Determinants of Land Capability which was prepared by M. F. Goodchild and published by the Lands Directorate of Environment Canada in 1976. The study area for this analysis is the Roseau River Drainage Basin located in Southern Manitoba, (part of the 1:250,000 Winnipeg Map Sheet 62H). The variables were analyzed on a quarter section basis using C.L.I. ratings for agriculture and recreation from the Canada Geographic Information System and physical variables from the Canada Department of Agriculture. For the soil capability classification for agriculture only the dominant class is analyzed where there are complex ratings. The physical variables were transferred from base maps and digitized for computer input.

The following variables were analyzed; soil depth to water table, surface pH, surface texture, salinization and alkanization, surface water retention capacity of soil parent material, natural fertility, drainage, topography, landforms, and surficial material. Methods of analysis included regression, cross-tabulation, and analysis of variance, and the following relationships with the soil capability classification for agriculture were found.

> The most important numeric physical variable is natural fertility, which alone explains 33.1% of the variation is capability. The remaining variation is best explained by drainage, when the effect of natural fertility is held constant. The next step introduces landforms, for a total explanation of 43.1% of the variation in capability. The best capability values occur on fertile, rolling land with relatively poor drainage. The Alpha variables, surficial and parent materials, show very strong associations with capability...Variation in parent material is able to account for 52.9% of the variation in capability and this rises to 61.3% when coupled with the effects of natural fertility, drainage and landforms.[176]

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[176] Environment Canada, Lands Directorate The Determinants of Land Capability, by M. F. Goodchild, University of Western Ontario, 1976, p. 21.

The indication that the best capabilities occur on fertile, rolling land with relatively poor drainage is difficult to comprehend as one would assume that rolling land is well drained except in depressions.

The following results were obtained when the variables were compared to the land capability classification for recreation. Using regression analysis,

> the best explanatory variable appears to be surface texture, although the relationship is clearly weak. Surface pH indicated an association between good recreation capability and alkaline soils. Analysis of variance indicated that deltaic deposits tended to be associated with good recreation capability while calcareous till was characteristic of poor capability.[177]

The results of the study indicate that there are positive relationships between certain physical parameters and the soil capability classification for agriculture. However, this is to be expected since these parameters are the criteria which determine the capability ratings. It is also to be expected that there would not be a correlation between the physical parameters and the recreation classification. This classification is based on a variety of features which are determined by a number of widely different physical characteristics.

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[177] Ibid., pp. 58-59.

2. Alternative Information Systems

The problems associated with the development of the Canadian Geographic Information System led to the creation of a number of provincial information retrieval systems in the late 1960's and early 1970's.

As previously discussed, the Regional Development Branch of the Ontario Department of Treasury and Economics described a sieve mapping technique in their 1970 report *The Land Capability Analysis Component of Ontario's Regional Development Plans*. The limitations of this sieve mapping technique resulted in the development of a computer system for resource analysis. The spatial unit that was chosen for data collection and analysis was the four square kilometre unit. This is based on the Universal Transverse Mercator grid system which is the same as used on 1:50,000 National Topographic Maps.

The mechanics of the Computer program are as follows.

> The program starts at the top of the map and processes the data horizontally, row by row, and from left to right in each row. The actual data values recorded for the grid cells are generalized into groups and each group is assigned a graphic symbol which is used in printing the spatial diagram. A cell can be represented by a single symbol. The program permits the user to specify the number and levels and the relative size of each of the levels in the range of data after the maximum value of the data has been determined.[178]

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[178] Ontario Department of Treasury and Economics, *The Land Capability Analysis Component of Ontario's Regional Development Plans*, 1970, p. 27.

A manual process is used in preparing the data for computer input. Firstly a four square kilometre grid is superimposed over the 1:50,000 C.L.I. map. Acreage totals within each grid cell are then compiled with the use of a polar planimeter. The acreage values represent the data which are finally placed in the computer. Output from the system is in either tabular form or grid map. Each four square kilometer cell on the map is assigned a value and this value is presented in one of a number of dot and line patterns of various intensities.

A second stage in the development of the computer model included the introduction of locational weighting variables based on land use capability classes.

> For example, for a given type of land use such as Class 1 Agricultural Land, marsh land constitutes a locational constraint and hence, in that region allocated by the model in Stage 1 to Class 1 Agricultural Land there will be discontinuities in the surface. The next best land use will then come in and again be investigated by the model in terms of its constraints and so for each land use in descending order of preference for each area where the most desirable uses are excluded by land us capability constraints.[179]

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[179] R. B. Corbin, A Potential Model for Land Use Allocation, Proposed Research on Land Use Analysis, Regional Development Branch, Ontario Department of Treasury and Economics, June 1970, p. 17.

It was hoped that this type of analysis would enable planners to develop a weighting system between the capability classifications and individual classes. The development of such a system of assigned values for various capability ratings would result in the creation of a composite resource potential map.

In 1970 the Manitoba Department of Mines and Natural Resources prepared a report entitled Feasibility Study Resource Data Systems. One of the objectives of this study was to develop a computer system which would enable Canada Land Inventory data and other resource information to be compiled, stored and accessed in a manner suitable for comparisons and analysis. The system was also to be compatible to the Canadian Geographic Information System. Another objective was to document the data needs of resource agencies in the Province and to catalogue the types of data generated by these agencies.

The computer system that was developed in the study was called the Data Cell System. This storage and retrieval system displayed information through a television monitor (cathode ray display screen).

> The data is stored on a data cell - a random access storage unit consisting of a series of magnetic strips each capable of holding 400 million characters of data. The term 'random access' means that the computer does not need to run through all the data sequentially before selecting the desired piece.[180]

The quarter section was chosen as the unit of input for the computer model, and data from the agricultural capability and present land use classifications were inputed on an acreage basis. This information along with other types of resource data could be retrieved and viewed on a console terminal. Hard copy or print out of the information shown on the screen could also be provided. The output of the system, however, was strictly the same as the input and manipulation of the data was not possible.

An appraisal of the feasibility study pointed out the importance of using the quarter section since considerable information was already collected on this unit area. The importance of analyzing the accuracy and reliability of each data source was also noted.

> One question that may be asked concerns the geographical units of areas for which it is desired to bank data. Is the ARDA system (C.G.I.S.) suitable for banking large amounts of data on the relatively small quarter section unit for area used in the Prairie Provinces? The answer to this question by ARDA at present

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[180] Manitoba, Department of Mines and Natural Resources, Canada Land Inventory Project, No. 12, Feasibility Study Resource Data Systems, 1970, p. 53.

> is that the system has the flexibility of banking data at any base, or as many different data bases as is desired.[180]

The importance of the quarter section has been identified by Manitoba in 1970, but as indicated in a 1976 evaluation of C.G.I.S. the quarter had still not been defined in the C.G.I.S. data base. The practicality of using the quarter section in the Prairie Provinces had been ignored by the Federal Government.

Several important observations and recommendations resulted from the feasibility study and they are very relevant to the establishment of any computer retrieval system.

> There is sometimes a tendency to disregard the user's needs and constraints. Efforts directed towards the design of information systems become an end in themselves - systems so designed may or may not have effective or efficient applicability.
>
> The Geo-Information System research project, initiated in 1966, has as its objectives the design of an information handling system which would permit the storage, analysis and retrieval of map and statistical information by computer. To date the practical results of this project have been nil. In the light of other research which has been undertaken elsewhere, should not the federal government re-examine their Geo-information project in terms of:

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[181] _Ibid._, p. 162.

> a) Is the project still viable in terms of need and other tools now available which will permit the practical application of some of the capabilities being designed into the Geo-Information project?
>
> b) Should the federal government have all its research funds in one project?
>
> Pilot experimental information system models, developed in Manitoba indicate that further studies are warranted into the practical application of random access, remote display terminals and microfilm techniques.
>
> Research indicates that the establishment of any comprehensive information system to handle resource data is extremely complex.[182]

The Manitoba feasibility study has provided a detailed evaluation of provincial needs for an information and retrieval system. This 1970 study questions the value of the Canadian Geographic Information System and the concerns expressed appear to have been valid.

A number of lesser known information and retrieval systems have also been developed throughout Canada since the creation of the C.L.I. Many never got past the research stage but a few did survive and became operational. A Score Map System was developed by Hough, Stansbury and Associates Ltd., who prepared the Lakealert Phase 2 Methodology Report for the Ontario Ministry of Natural Resources. An environmental data bank was developed by the School of Urban and

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[182] Ibid., p. 15 - 17.

Regional Planning, University of Waterloo, and the Canadian Forest Service developed the Map Information and Display System. The Lands Directorate of Environment Canada and Parks Canada developed the (PLUS) Planning Land Use System. This system was designed (1) to overcome some of the difficulties apparent in the Canadian Geographic Information System and (2) to be readily accessible to land use planners.

These systems were either based on the fixed grid or polygon mode. The polygon approach was more accurate than the fixed grid and was independent of input scale, orientation and projection. The fixed grid system was much less expensive and could be adopted by agencies with limited finances.

The development and operation of computer information and retrieval systems is an extremely specialized field of research, and it is beyond the terms of reference of this study to provide a detailed evaluation of their pros and cons. Several have been mentioned to provide some insight into the work that has been done and their relevancy to the Canada Land Inventory.

CHAPTER IX

THE ALBERTA EXPERIENCE

Emphasis to this point in the study has been on the utilization of the C.L.I. outside of Alberta. The important section on land capability analysis has contained few references to research in the Province. However, Alberta Government resource agencies have been leaders in the analysis of the C.L.I. and Alberta has probably made a greater contribution than any other province. The research is not widely known outside the province because, unlike many other provinces, the work was done 'within house' and did not receive the financial support and involvement of the Lands Directorate and the Federal Department of Regional Economic Expansion.

1. Peers-Whitecourt Land Use Study

The Alberta experience began in 1969 with the development of the Peers-Whitecourt Land Use Study. On January 14, 1969 the Planning Branch of Alberta Municipal Affairs received a request from the Lands Division of Alberta Lands and Forests to prepare a land use study along highway 32 between Peers and Whitecourt. The land use study area - 1,253 sq. km. (484 sq. mi.) is located in west-central Alberta and extends for approximately 64 km. (40 mi.) from highway 43 in the north to highway 16 in the south. The town of Whitecourt is located in the northern portion of the region at the confluence of the McLeod and Athabasca Rivers. The hamlet of Peers is located 5 miles north of highway 16.

(a) Description of the Study

The original intent was to conduct a land use study along highway 32 between Peers and Whitecourt regarding the suitability of the area for small holdings. However, it was felt that any study in the area must be more comprehensive and include additional land uses. The study area was also expanded to include areas suitable for recreational and country residential development.

The study documents the physical, social and economic factors which are characteristic of any land use study. The difference between this study and previous ones is that an attempt was made to utilize the Canada Land Inventory in assessing the renewable resource potential of the area. The study team wanted to be able to compare the various capability classifications to each other, for a specific land area, in order to determine the best resource potential for that area. It was also decided that the C.L.I. capability data should be converted to a quarter section basis. The quarter section was chosen for several reasons: it was felt that the C.L.I. was accurate at this level, the land disposition system of the Prairie Provinces was in terms of townships, ranges and quarter sections, many types of resource data including assessment records were already collected at this level, and the quarter section appeared to be readily suited to computer conversion.

A major problem in the conversion of the C.L.I. information was the transfer of the original data with its physical boundaries to the quarter section grid. For the purpose of the Peers-Whitecourt study it was decided the particular capability class which covered the largest surface area for a specific quarter section would be recorded and thus represent the rating for the entire quarter. To provide additional information, assessment data for each quarter were also included. Crude data sheets were devised and the information was placed in storage at the Provincial Data Centre in the following format:

TABLE 65

RESOURCE DATA COMPUTER INPUT
PEERS-WHITECOURT LAND USE STUDY

GLEN LAFSERCH	
1785	L1
QUARTER	NEQ31-53-13-5
ARABLE	12400 (124 acres)
PASTURE	02500
BUSH	01000
FINALPRC	029(final percentage discussed on page 188)

TABLE 65...continued

RECCAP	6UOEP (recreational capability)
TEXT	
MA#FC	4W9 6W1 (forest capability)
MA#WC	6TF (waterfowl capability)
MA#UC	3TF ME (ungulate capability)
MA#SG	GW (soil group)
MA#SS	N SD (subsoil)
MA#TE	LTL (texture)
MA#TO	GR (topography)
MA#AC	075W3 (agriculture cap.)
MA#ST	S1 (stoniness)
MA#BD	T_2T_4 (bush density)
MA#D1	J. A. DELE (disposition)

Having established the data base the next phase of the study involved the preparation of a priority system for the allocation of renewable resources. Some of the factors that were considered included markets for various agricultural products, demand for recreational facilities, location of roads, assessment records, and forestry operations. These factors were then combined with the C.L.I. information to establish the following priority of allocation:

1. Outdoor Recreation - The highest recreation capability in the area was class 4 and because of its scarcity it received the first priority. The study called for it to be reserved for moderately intensive recreational use.

2. Forestry A - Class 3 forestry capability lands were allocated in this category. Although some of these lands were patented and in agricultural use, it was felt that because of their scarcity they should still be placed in a forestry category. In keeping with a policy of integrated land use, complementary uses of these lands included recreation, wildlife production and watershed protection. Only selective cutting to maintain the quality of the timber was recommended. These class 3 lands were located in the valley bottoms of the McLeod River and Athabasca River east of Whitecourt. From an agricultural perspective these same lands were quite valuable; however, in evaluating the long term implications of land use in the area for recreation, ungulates and watershed it was decided to place them in the forestry A category.

3. Agriculture A - Only areas with a class 4 agricultural rating and a limitation of 'd'(undesirable soil structure and/or low permeability) were allocated at this level. The study indicated that these areas could be marginally arable for crops but were more amenable to forage and pasture.

4. Forestry B - This land was rated class 4 for forestry and from class 4 to 7 for agriculture. The prime use would be for the production of pulpwood. Unimproved grazing would be

allowed to assist uneconomic farm units. In addition extensive recreation was recommended along the McLeod, Sakwatamau and Athabasca rivers.

5. Agriculture B - This category contained a combination of class 4 and 5 agriculture capability areas. The study indicated that the land should be used for improved grazing and could possibly support forage crops.

6. Forestry C - This category contained all lands not previously assigned. Land was indicated as being best suited to forestry, primarily for pulpwood, and to unimproved grazing.

The priority table that was developed for the allocation of quarter sections to these categories is as follows:

TABLE 66

PRIORITY TABLE
PEERS-WHITECOURT LAND USE STUDY

1. Recreation	C.L.I. Rating
a) Agriculture capability	any
b) Forest capability	any
c) Recreation capability	4
d) Ungulate	any
e) Waterfowl	any

TABLE 66...continued

	C.L.I. Rating
2. **Forestry A**	
a) Agriculture	any
b) Forestry	3
c) Recreation	5, 6, 7
d) Ungulate	any
e) Waterfowl	any
3. **Agriculture A**	
a) Agriculture	4d, 4d9, 4d8, 4d7
b) Forestry	4, 5, 6, 7
c) Recreation	5, 6, 7
d) Ungulate	any
e) Waterfowl	any
4. **Forestry B**	
a) Agriculture	4m, 4s, 4t, 5m, 5c, 5d, 5t, 6m, 6t, 0
b) Forestry	4m, 4w, 4x
c) Recreation	5, 6, 7
d) Ungulate	any
e) Waterfowl	any

TABLE 66...continued

5. Agriculture B	C.L.I. Rating
a) Agriculture	4m, 4s, 4w, 5c, 5m, 5w, 5t
b) Forestry	5m, 5w, 5x
c) Recreation	5, 6, 7
d) Ungulate	any
e) Waterfowl	any
6. Forestry C (Process 1)	
a) Agriculture	6m, 6t, 6w, 7w, 7t, 0
b) Forestry	5, 6, 7
c) Recreation	5, 6, 7
d) Ungulate	any
e) Waterfowl	any
Forestry C (Process 2)	
a) Agriculture	5c, 5m, 5w, 5t
b) Forestry	5w, 6, 7

Forestry C was broken into two sections to allow different combinations of agriculture 5 and 6 and Forestry 5 and 6 to be identified.

Source: Alberta, Municipal Affairs, Peers-Whitecourt Land Use Study, 1970.

A major research function within the Peers-Whitecourt study was the development of a computer program to search and retrieve the C.L.I. data in order that quarter sections could be allocated according to the established priorities. The System 360/Document Processing System was supplied by I.B.M. of Canada to the Provincial Data Centre which in turn made it available to Alberta Municipal Affairs.

> The principle on which this program operates is based on a system of keywords. The system works on a series of indices consisting of the location of such keyword with respect to its neighbours, each sentence in its paragraph and each paragraph within its document. In addition, an index of the number of occasions a keyword appears in an entire file of documents is provided as well as the location of each appearance ...The Canada Land Inventory information for each land unit was presented in phrases. In each phrase, the type of classification (i.e., agriculture, forestry, etc.); and the dominant class were included as well as the limitations or attributes of the particular land unit. The percentage of the various class rating per unit was also found in the same phrase.

Considerable testing was conducted on the system to adapt it to the needs of the study. The problems were eventually solved and it became fully operational. The system did, however have two major limitations. The Document Processing System could not do

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[183] Alberta, Municipal Affairs, Provincial Planning Branch, Research Division, Peers-Whitecourt Land Use Study, 1970, p. 87-88.

calculations and its output was in vertical format. At nineteen lines per quarter section the output had a tendency to become quite unwieldy.

It is interesting to note that the Document Processing System used in the Peers-Whitecourt Land Use Study was modified from a system employed in Glenrose Provincial General Hospital in Edmonton. The purpose of the Glenrose system was to document symptoms of known illnesses to aid in identifying unknown illnesses of patients.

Another important component of the Peers-Whitecourt study was the identification of sites suitable for country residences. As with the priority table the computer program was used in this component. The capability classifications of the Canada Land Inventory were analyzed and lands having good potential for tree growth, variation in topography and relatively low agricultural capability were selected.

Based on the following criteria 127 quarter sections were considered as physically suited to development.

TABLE 67

SUBCLASSES SUITED FOR COUNTRY RESIDENCES

Agriculture Capability	5c, 5d, 5m, 5t, 6m, 6t
Forestry Capability	4m
Recreation Capability	5e, 5o, 5p, 5q
Waterfowl Capability	6t
Ungulate Capability	2, 2W, 3

These 127 quarter sections were further examined with respect to location, demand, accessibility, availability of electric power and telephone, existing land use and disposition. Having analyzed these factors 38 quarter sections which were suited to country residential development were selected.

(b) Comments and Evaluation

The study was released by Alberta Municipal Affairs to other government agencies in mid 1970, and it immediately generated considerable discussion. This was the first attempt in Alberta to combine the C.L.I. capability classifications in the creation of an allocation process. It was also the first time that the data had been computerized and transferred from natural boundaries to quarter section units. The study also represented the first attempt by the Provincial Planning Branch to become involved in regional land use analysis. The management of renewable resources on Crown lands had been the responsibility of the Department of Lands and Forests and this was the first attempt by an 'outside' agency to place this resource data in a planning framework.

Overall reaction to the study was quite favourable; however, there was criticism over the interpretation of the resource information. Of prime importance were those comments on the use of C.L.I. data and the study methodology. Comments of F. W. McDougall, Head of the Timber Management Branch included the following:

> The methodology used by the Provincial Planning Branch seems to have resulted in fair and equitable land use allocation in the area. There may be one weakness which should be considered. The proposed land use plan shows a number of isolated quarters which are out of context with the surrounding use designation. Some quarters are assigned for forestry that are isolated completely within large agricultural areas. Unless these quarters support well established young coniferous growth or are heavily forested they should be considered for inclusion in the surrounding agricultural zone. In other words, the proposed land use plan should be reconsidered in combination with up-to-date forest cover and topographical maps with a view towards removing isolated quarters from a separate land use category unless there are very strong reasons for retaining them under separate classifications.[184]

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[184] Alberta, Department of Lands and Forests, Timber Management Branch, correspondence from Branch Head, F. W. McDougall to R. G. Steele, Director of Forestry, August 26, 1970.

Most of the isolated quarters were removed from the final allocation map; however, it was necessary to include some of them as they were patented and it would be unrealistic to recommend a change of land use. It was also felt that the recommended uses of these isolated quarter sections would be compatible with adjacent uses. Some of the isolated quarters assigned to forestry B or C within agricultural areas were intended to serve the forest requirements (woodlots) of the farming population.

Although specific comments were not provided the Fish and Wildlife Division of Lands and Forests questioned the methodology. "We seriously question some of the methodology and question the apparent procedure used in application of the C.L.I. ungulate information."[185] The second question is quite relevant for on the proposed land use map no categories have been indicated for either ungulate or waterfowl as primary uses. Land suited to wildlife has been included as a secondary use in the Recreation and Forestry A categories. The entire McLeod and Athabasca river valleys are rated either class 1W or 2W and perhaps this area should have been allocated to ungulates with recreation and forestry as secondary uses. In retrospect it is just as well that this didn't happen for the area has subsequently been reclassified for ungulates with the McLeod and Athabasca river valleys being rated as class 3W.

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[185] Alberta, Lands and Forests, Fish and Wildlife Division, correspondence from G. R. Kerr, Chief Wildlife Biologist to J. Markovich, Supervisor of Special Land Uses, September 1, 1970.

J. A. Schalkwyk of the Technical Division of Alberta Lands and Forests expressed concern regarding the methodology.

> The procedure followed in determining best use appears reasonable, however the final results are not practical. A re-evaluation of the priorities for the physical as well as the socio-economic criteria would appear to be necessary and also a close check on the plotted computer results. In our opinion some of the weaknesses in the priority rating are as follows: A more detailed set of socio-economic criteria is required to further qualify best use on a physical basis. Insufficient appreciation of the meaning of capability ratings, limitations and management requirements of each use is evident. Token consideration of multiple use concepts introduced a bias in the determination of priorities.[186]

In addition to Provincial Agencies the Federal Department of Regional Economic Expansion was requested to review the study, and the comments received were very critical.

> Your use of C.L.I. data in planning is very encouraging since one of the major reasons for compiling the capability maps was for that very purpose; however, I must express some alarm and concern over the method in which the maps were analyzed and integrated. Your selection of a priority system for

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[186] Alberta, Lands and Forests, Technical Division, correspondence from T. A. Drinkwater, Director to N. Dant, Director Provincial Planning, Municipal Affairs, October 19, 1970.

> comparing the various C.L.I. capabilities using 'social and economic demands, development policies of government agencies and private individuals' follows traditional methods. The proposed land use plan completely ignores the fact that some of the best moose, deer and elk habitat in the whole of Alberta occurs within the study area. Also, four class 4 waterfowl marshes are present but are not identified in the proposed land use map even though waterfowl capability deals mainly with wetlands and seldom conflicts with other resources. By weighting decisions using factors of economics and government policy, I feel you are pre-empting the C.L.I. classification system and largely defeating its purpose. Generally the study was disappointing and gave the impression of being too shallow in a number of sectors. Treatment of the C.L.I. capability data was such that it tended to mask the values identified in the raw data.[187]

In total the Department of Regional Economic Expansion provided eight pages of criticism. Much of this was based on the lack of wildlife designation within the study, and it was recommended that classes 1W and 2W for ungulates should have priority over all other uses except for class 3 forestry. The comments further suggest that too much emphasis was placed on socio-economic factors and not on the actual values of the C.L.I. ratings. However, the final allocation was based primarily on the C.L.I. ratings and socio-economic factors were included only to ensure that the study maintained a sense of reality. The reality (facts of life) of the Peers-Whitecourt area have been ignored in the comments of the Department of Regional Economic Expansion.

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[187] Canada, Department of Regional Economic Expansion, correspondence from P. B. Dean, Land Use Planning Co-ordinator, C.L.I. to W. W. Warren, Head Research Division, Alberta Municipal Affairs, March 24, 1971.

In fact the authors of the Peers-Whitecourt study were somewhat shocked by the comments from Ottawa. The leadership that was expected from DREE was completely lacking and their comments referred to matters which indicated a complete lack of knowledge of the Alberta situation. Alberta Municipal Affairs had hoped to receive construction criticism on the methodology aspects of the study but no comments were received on the computer application and the transfer of data to the quarter section grid.

The Department of Regional Economic Expansion had provided funding for a variety of C.L.I. related studies throughout Canada, but Alberta Municipal Affairs had received none. The Peers-Whitecourt study had been prepared completely at Provincial expense and some unique concepts for the use of the C.L.I. had been developed. Instead of encouraging this type of work DREE had been severely critical.

Overall, the comments received by the Provincial agencies were much more helpful than those received from DREE. Of particular importance is a review prepared by Ken Wilson of the Provincial Planning Branch in 1972.

The basic strength of the Peers-Whitecourt Land Use Study is its use of comprehensive data on the physical features and renewable resource base of the area. The fact that these data are also rated for the capability of the land to produce the basic resources of timber, agriculture, wildlife and for the attractiveness of the resource base for recreation pursuits makes it very meaningful for regional planning.

While the information base for the resource section of the plan is good, there are some weaknesses to the study which limit it from comprising all or part of a regional plan. The first of these is the lack of specific research into the economic and social conditions of the population of the area especially with respect to the communities within the study area. The second weakness is the very small area studied and the lack of regional or provincial perspective as applied to the analysis of and recommendations for the resource base of the area. By not applying a provincial perspective to analysis of the study area recommendations for land use in the area may very well have been taken out of context with development of the same land resources in the remainder of the provinces.

Another weakness in the Peers-Whitecourt Land Use Study is the display of the final recommendations on an isolated quarter section basis. In agriculture groupings of quarter sections should be made to determine viable farm units, in forestry a total unit of land with sufficient area to support a forest industry should be designated. The quarter section should only be considered the unit for information collection and manipulation. Using the quarter section is a means to the end of efficient and logical resource allocation but it is not an end in itself. [188]

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[188] Alberta, Municipal Affairs, Provincial Planning Branch, Peers-Whitecourt Land Use Study, A Critique by Ken Wilson, February 1972.

Some of these points, especially those on the lack of a provincial perspective, and the designation of isolated quarters were very relevant and later studies reflect these issues.

Alberta Lands and Forests in 1971 recommended that the report not be released to the public and indicated that it be used internally for guidance. However, the Provincial Planning Board insisted that the report be released for various municipal authorities and the Farm Adjustment Committee had been involved in its preparation. The report was eventually released but included a covering letter from the Chairman of the Provincial Planning Board indicating that the study was intended to assist local and provincial administrators in making land use decisions but the recommendations were not to be construed as government policy.

In 1972 a Development Control Directive pursuant to the Development Control Bylaw for those portions of Improvement Districts 14 and 15 covered by the Peers-Whitecourt study area was prepared. A land use guide was adopted and contained the following use categories: The recreation and forestry A categories of the original study were combined into a single recreational category. A highway corridor category was established along the major routes and the thirty-eight sites recommended for country residences were designated for that specific use. Remaining lands within the study area were assigned to both agriculture and forestry without a specific allocation being made. It was felt that the Peers-Whitecourt study was not sufficiently detailed to provide for the assignment and separation of different levels of agricultural and forestry use.

Although the Peers-Whitecourt study had numerous deficiencies it was carried through to a legislative implementation level. This in itself was considered important, for many studies never get past the research stage. More significant was the fact that the study was the catalyst for an intensive program of research into the use of the C.L.I. in Alberta.

2. Development of the Land Use Planning Data Bank and Computer Methodology

The completion of the Peers-Whitecourt Land Use Study and the general acceptance of the methodology developed in the study by Alberta Municipal Affairs resulted in a new era of resource analysis in the province.

The Land Use Assignment Branch of Alberta Lands and Forests had been involved in the preparation of bio-physical land classification studies since the mid nineteen-sixties. This system was based primarily on the bio-physical classification developed by G. A. Hills in Ontario and involved the conversion of the Canada Land Inventory capability classification data to bio-physical units.

Another method of resource analysis was also being investigated in Alberta Lands and Forests. In 1970 under the Canada Land Inventory Pilot Land Use Planning Program an agreement was signed between the Province of Alberta and the Government of Canada which would allow Alberta Lands and Forests to conduct a land use planning study in the Southern Foothills Region of Alberta.

In 1970 Alberta Municipal Affairs initiated two major land use studies, the Hinton-Yellowhead Regional Land Use Study and the Lesser Slave Lake Regional Plan. These two studies were to be based on the methodology developed in the Peers-Whitecourt study, but it was obvious that new techniques of analysis would be required. The Peers-Whitecourt area covered 1,253 sq. km. (484 sq. mi.) while the combined area of the two new studies was 81,554 sq. km. (31,500 sq. mi.).

Thus, in the early 1970's three Alberta Government Agencies were involved in the preparation of resource land use studies and the methodology was different in each case, although the resource base, the Canada Land Inventory, remained the same.

(a) Establishing the System

The Research Planning Section of Alberta Municipal Affairs was assigned the responsibility for the preparation of both the Hinton-Yellowhead and Lesser Slave Lake studies. Like the Peers-Whitecourt study, both would investigate a number of socio-economic components of land use planning but the emphasis would be on renewable resource analysis. The capability classifications of the C.L.I. would provide the resource base for this analysis; however, considerable research would be required to refine the computer and allocation methodology which had been previously developed.

To ensure uniformity in the preparation of resource land use studies being prepared by Alberta Municipal Affairs and Lands and Forests,a Land Use Planning Technical Co-ordinating Committee was established and the first meeting was held on October 20, 1970. Represented on the committee were the Research Planning Section of Municipal Affairs and the Multiple Use Planning and Land Use Assignment Sections of Lands and Forests.

> Discussion initially focused on the necessity of having a common methodology. Mr. Schalkwyk stated that an attempt should be made to uncover the best methodology, but the different methodologies can be used as long as the final product is the same. Mr. Giffen expressed interest in discussing the types of data units being used in land use studies and how the use of these units would affect correlation of studies. Mr. Schalkwyk felt that the land form unit and the quarter section unit were very much alike. This was followed by a general discussion on the treatment of Canada Land Inventory data and clarification of how each study utilizes these data in physical resource analysis. [189]

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[189] Alberta, Government, Minutes of Meeting of Land Use Planning Technical Co-ordinating Committee, October 20, 1970.

The Land Use Planning Technical Co-ordinating Committee agreed that the Glenrose Computer System (formerly D.P.S. 360 system) employed in the Peers-Whitecourt Land Use Study should be expanded to serve the needs of the Foothills Resource Allocation Study, Hinton-Yellowhead Regional Land Use Study and the Lesser Slave Lake Regional Plan. The computer would not be used by the Land Use Assignment Branch as it was felt that their study areas were too small to gain advantages from the system.

The committee in their first meeting endorsed the idea of establishing a land use planning data bank. It was felt that the information generated from the three major land use studies that were to be prepared should be stored and combined with other types of data. The data bank it was hoped would gradually be expanded to cover the entire province. The unit of input for all data in the system would be the quarter section. It had been successfully utilized in the Peers-Whitecourt study and offered potential for the storage of many types of information.

Subsequent meetings of the committee evaluated in detail the function and operation of the proposed computer system and data bank. The ultimate function of the system was to provide an organized approach to the storage and retrieval of resource information. Such a system would be extremely complex and it was critical that from the outset a standardized procedure be developed for the input of data.

The major purpose of the data bank was to facilitate the manipulation of C.L.I. capability classification data. Both the Research Planning Section and the Multiple Use Planning Section intended to code C.L.I. information at a quarter section level for their respective study areas. In total approximately 200,000 quarter sections would be coded for each of the capability classifications. Assuming that information was available for the seven C.L.I. classifications this would result in 1,400,000 entries into the data bank.

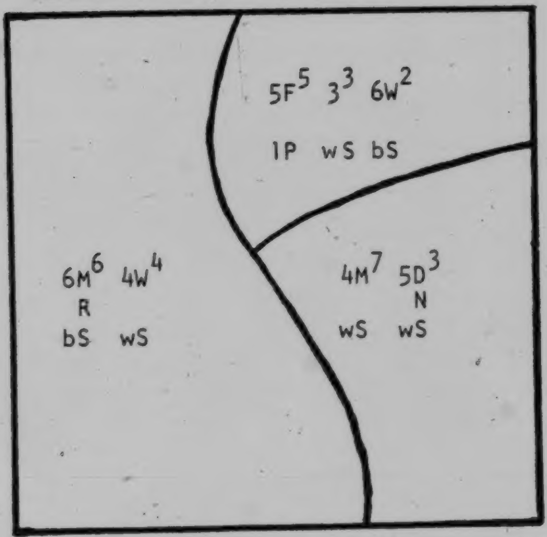
Such an extensive program would require rigid controls and closely defined procedures. In May 1971 the Research Planning Section of Alberta Municipal Affairs prepared a procedures manual entitled A User-Oriented Summary and Description of the Data Base, Data Processing System and Computerized Document Retrieval System Employed in Regional Land Use Studies. The manual describes the method by which thirty-six pieces of information can be coded and inputed into the data bank.

(b) Coding Procedures

The coding and control of the format by which the information would be inputed into the system required considerable research. In the Peers-Whitecourt Land Use Study the capability class which covered the largest part of the quarter section was recorded and thus represented the rating for the entire quarter. To improve upon this method it was decided the C.L.I. capability information would be recorded in order of magnitude down to 10% of the area of the quarter section. The portion of the quarter covered by each rating would thus be indicated in 1/10 integrals. The percentages were visually calculated from the 1:50,000 or 1:63,360 capability classification maps and the ratings were transferred to data sheets which were specifically designed for the land use planning data bank. The following example illustrates the procedure utilized in the transfer of data from a typical quarter section unit of a forestry capability map.

FIGURE 2

CODING OF TYPICAL QUARTER SECTION WITH FORESTRY CAPABILITY RATINGS



The entry on the data sheet for this quarter section would be:

DOC NO.b̸b̸MA#FCb̸6MRB64W?W45b̸4M?W75ĐNW33b̸5F?L53??W36W?B22

The interpretation of this phrase is as follows:

DOC NO. - document number

ƀƀ - 2 blank spaces

MA# - Municipal Affairs

FC - Forestry Capability

ƀ - blank space

6 - class 6

M - subclass (limitation) soil moisture deficiency

R - subclass (limitation) restriction of rooting zone by bedrock

B - indicator species--black spruce

6 - 60% of this complex rating

4 - class 4

W - subclass--soil moisture excess

? - fill-in character (2nd limitation does not exist)

W - indicator species--white spruce

4 - 40% of this complex rating

5 - unit covers 50% of quarter section (visual calculation)

ƀ - blank space

4 - class 4

M - subclass--soil moisture deficiency

? - fill-in character

W - indicator species--white spruce

7 - 70% of complex rating

5 - class 5

~~D~~ - subclass--physical restriction to rooting by material other than bedrock

N - subclass--excessive levels of toxic elements such as soluble salts

W - indicator species - white spruce

3 - 30% of complex rating

3 - unit covers 30% of quarter section (visual calculation)
ƀ - blank space
5 - class 5
F - subclass - low fertility
? - fill-in character
L - indicator species - lodgepole pine
5 - 50% of complex rating
3 - class 3
? - fill-in character (no limitations)
? - fill-in character (no limitations)
W - indicator species - white spruce
3 - 30% of complex rating
6 - class 6
W - subclass - soil moisture excess
? - fill-in character
B - indicator species - black spruce
2 - 20% of complex rating
2 - unit covers 20% of quarter section (visual calculation)

The same procedure was followed in the coding of the other capability classifications with the exception of Present Land Use. For this classification the area covered by each rating in the quarter section is recorded in 1/16 integrals (4 hectares/10 acres) instead of by tenths. The present land use maps often included parcels of land as small as 4 hectares (10 acres) and for this reason it was considered necessary to intensify the level of input. By using 1/16 integrals it would be easy to directly relate them to acres which were considered more important in this classification than in the other ones.

(c) Attributes of the System

Having developed an acceptable method for the input of data into the computer system the next step involved the retrieval and display of this data. The retrieval system was based on that developed for the Peers-Whitecourt study, but numerous refinements to accommodate the massive increase in input were made. As previously indicated the system was structured from the Glenrose Hospital Patient Information Retrieval System (G.H.P.I.R.S.).

All information within the system was stored and could be retrieved by legal description at the quarter section level. Sub-regions within both the Hinton-Yellowhead and Lesser Slave Lake study regions could be searched by providing a listing of townships and ranges and the relative meridians.

The format of the output was similar to that of the Peers-Whitecourt study but it had now been expanded to include all classes within the quarter section in excess of 10% or 6.25% in the case of present land use. Initial studies included the legal description (S.W. 14-57-22-4) as part of the output; however, this was later converted to numerals and the order was reversed to simplify coding and the operation of the system (422057142). The interpretation of this number is as follows:

4 - meridian
22 - range
057 - township
14 - section
2 - S.W. quarter

The quarter sections are numbered clockwise starting with the south-east.

As has been indicated the input of C.L.I. information, especially where complexing is involved, is quite detailed, and a printout of this material would be difficult to interpret for one not familiar with the system. However, the system does have the ability to generate the information in literal format as indicated in the following table.

TABLE 68

CONVERSION OF C.L.I. COMPUTER PRINTOUTS TO LITERAL FORMAT

Computer printout AC 4D.06 0..02 4ST75MF 16T.22 becomes:
Soil Capability for Agriculture

Class 4 - severe limitations
Limitations - adverse soil structure
Covers - 100% of 60% of quarter section

Class 0 - organic soils
Covers - 100% of 20% of QTR SEC

TABLE 68...continued

Class 4 - severe limitation
Limitations - adverse soil characteristics and adverse topography
Covers - 70% of 20% of QTR SEC

Class 5 - perennial forage crops - improvement feasible
Limitations - droughtiness and low fertility
Covers - 10% of 20% of QTR SEC

Class 6 - perennial forage crops - improvements not feasible
Limitations - adverse topography
Covers - 20% of 20% of QTR SEC

This feature is especially useful in dealing with small areas where capability data is required for specific quarter sections. The Regional Planning Section of Alberta Municipal Affairs uses these printouts in the preliminary evaluation of subdivision applications.

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Complex ratings in agriculture and forestry have led to interpretative problems, for two or more complexes within a quarter section may contain the same class. This situation is illustrated in the above example when there are two class 4 areas within the same quarter section. Class 4 covers 100% of 60% of the quarter section and 70% of 20% of the quarter or in total 74%. In evaluating the potential of complex quarter sections it is often important to isolate this statistic and programs within both the agriculture and forestry classifications have been established to accomplish this task.

Results of the capability analysis in the Peers-Whitecourt study were printed by the computer in a linear format. A computer mapping program was not developed. However, due to the magnitude of the Hinton-Yellowhead and Lesser Slave Lake studies it was considered essential that a computer mapping process be developed to handle output. Initial output from the Hinton-Yellowhead Regional Land Use Study was displayed through the SYMAP mapping program. The Harvard Centre for Environmental Design Studies had developed this system for the purpose of producing maps to illustrate graphically the spatial distribution of quantitative and qualitative data. The Government of Alberta had purchased the SYMAP program and it was being utilized by the Department of Agriculture. The program was adopted by the Research Planning Section of Municipal Affairs to prepare maps which would show information according to quarter section units. SYMAP was ideal for showing several variables but its effectiveness decreased as the number of variables increased. Each variable is displayed through the printing and over-printing of dots, lines, zeros, crosses, etc. The number of options is limited and maps are difficult to interpret if more than five patterns are shown.

The Research Planning Section realized that the potential of the SYMAP system was limited for it was anticipated that analysis of the capability classifications would generate a vast array of variables. A mapping system was required which would be economical to operate and effectively display at a quarter section level the required information. The mapping capability of the Canada Land Inventory Geographic Information system was investigated, but the system had never really been operational and it was certainly well beyond the financial resources of the Research Planning Section and Alberta Municipal Affairs.

MIADS (Map Information and Display System) developed by the Canadian Forestry Service was also evaluated. This system could be adapted to the Glenrose system but it was felt that it would prove to be costly and not really meet the needs of the Research Planning Section.

Alberta Municipal Affairs eventually developed its own system which proved to be easy to manipulate and inexpensive to operate. The system was basically the same as SYMAP except that numbers replaced the symbols used to display quarter section output. Each quarter section was represented by a two digit number from 00 to 99 and this greatly increased the capability of the system over SYMAP regarding the number of variables that could be displayed. The major disadvantage of the system was that it was virtually impossible to visually interpret the maps because of a lack of contrast in the patterns created by the numbers. It was usually necessary to colour these computer base maps to assist in interpretation. The system was easy to manipulate and would prove to be extremely useful in the preparation of the major land use studies by the Department. Much more advanced systems of computer mapping were available, but the Planning Branch could not expand its research beyond the capability of the Provincial Data Centre.

3. Determining Accuracy of Data Input Procedures (LUPDB)

As the Research Planning and Multiple Use Planning sections prepared themselves for the mammoth task of coding over 1,400,000 quarter sections several concerns were raised. During the preparation of the Pears-Whitecourt Land Use Study the accuracy of manually transferring C.L.I. data to quarter section units had been questioned. Visual estimates of percentages of capability classes within a quarter section would obviously have a certain degree of error, but how large would this error factor be. Both Municipal Affairs and Lands and Forests intended to hire staff under S.T.E.P. (Summer Temporary Employment Program) and P.E.P. (Priority Employment Program) to code the data, and it was felt that this inexperienced help would increase the chances of error.

(a) Accuracy in Transfer of C.L.I. Map Data to Coding Sheets

At numerous times throughout the coding phase 25 to 35 persons were involved in the transfer of C.L.I. data from 1:50,000 maps to coding sheets. Specifically trained personnel supervised the coding but the possibility of error was increased by the large turnover in staff. Many employees only lasted at the boring task of coding for three or four weeks.

A method was required to check on the error level in the coding, and surprisingly an error in the coding process provided the solution. Within the Hinton-Yellowhead region 13,467 quarter sections were coded twice for present land use and recreation. This coding was completed by different individuals and it was approximately a year before the duplication was detected.

The degree of error found between the two codings is indicated in table 69.

These figures indicate that there is some error in the visual calculation of classes within quarter sections but it is not serious. In the two separate codings of present land use 11,490 quarter sections out of 13,467 were coded identically. An accuracy level of 85.3% is quite remarkable especially in light of the fact that the information was coded in 1/16 integrals. Forty-seven point seven percent of the errors were only 1/16 of an integral while 79.4% were 2/16 or less (a 1/16 error would be 8T5U3K compared to 9T5U2K while a 2/16 error would be 8T5U3K compared to 10T4U2K or 9T6U1K). Errors that involved a change in class or land use were very rare.

TABLE 69

ERRORS IN MANUAL CODING OF CANADA LAND INVENTORY DATA

Present Land Use - total quarter sections investigated 13,467

Percentage of Error	No. of Quarters with Errors	Percentage of Total
6.25	944	7.0
12.50	626	4.6
18.75	221	1.6
25.00	110	0.8
31.25	41	0.3
37.50	14	0.1
43.75	21	0.2
	Total 1977	14.7

Recreation Capability - total quarter sections investigated 13,467

Percentage of Error	No. of Quarters with Errors	Percentage of Total
10	874	6.5
20	207	1.5
30	42	0.3
40	12	0.1
50	12	0.1
	Total 1147	8.5

In the two separate codings of the recreation capability classification 12,320 quarter sections out of 13,467 were coded identically. This represents an accuracy of 91.5%. 76.2% of the errors involved a change of 1/10 and 94.2% of the errors were 2/10 or less. (a 1/10 error would be 5UOQE8 5UQVE2 compared to 5UOQE7 5UQVE3 while a 2/10 error would be 5UOQE8 5UQVE2 compared to 5UOQE or 5UOQE6 5UQVE4). As with the present land use classification few errors were made in the change of class or subclass.

This accuracy test which involved a sample of 13,467 quarter sections has demonstrated that the visual transfer of data from map to coding sheet can be accomplished with a minimum of error. Visual perception of percentages of classes within quarter sections produces reliable results. Although calculations by planimeter or computer plotter would be more accurate,the cost and length of time to accomplish this task for those studies being conducted by the Alberta Government would be prohibitive.

(b) Accuracy of Quarter Section Allocation Techniques

After the completion of the Peers-Whitecourt Land Use Study and prior to the development of coding procedures for the Lesser Slave Lake and Hinton-Yellowhead studies,tests were conducted on the accuracy of recording C.L.I. information on a quarter section basis as opposed to using a planimeter. Township 59-R12-W5 south of

Whitecourt, Alberta was selected for the test through the random sampling technique. Acreage figures were calculated with the planimeter for each capability class unit within the township and these were compared to figures obtained by the visual process of assigning quarter sections to the class which covered the majority of the unit. (see table 70).
This table clearly illustrates that recording data on a quarter section basis through the technique utilized in the Peers-Whitecourt Land Use Study is not as accurate as measuring the data with a planimeter. Generally the larger the area the more accurate is the visual calculation. Since visual calculations are completed at the quarter section level and include only the class that covers the greatest percentage of the quarter many of the small areas have a high percentage error.

It is important to remember that these figures represent two techniques of recording data and the planimeter readings are based on measurements within the township. Classes were not measured with the planimeter for individual quarter sections. Thus, the planimeter readings could not be used for computer input on a quarter section basis. The tests were completed specifically to give an indication of the level of accuracy in visually measured classes.

Although the planimeter readings are more accurate than those obtained through visual calculations the time frame must be considered.

TABLE 70

TECHNIQUES FOR TRANSFERRING CANADA LAND INVENTORY DATA FROM MAPS TO CODING FORMS - TWSP. 59 RANGE 12 W5

C.L.I. Rating	Planimeter Calculation Sq. Miles Within Township	Percent of Township	Visual Calculation by ¼ section allocation - raised to Sq. Miles	Percent of Township	Difference & % Difference between Planimeter & Visual Calculations in Sq. Mi. (Planimeter Reading used as Base)	
	(Sq. Miles)	(%)	(Sq. Miles)	(%)	(Sq. Mi.)	(%)
Agriculture						
4d	10.56	29.3	12.00	33.3	+1.44	13.6
4d802	3.30	9.2	2.75	7.6	- .55	16.7
4s76t3	6.62	18.4	6.25	17.4	- .37	5.6
5m	.40	1.1	.50	1.4	+ .10	25.0
5td	4.36	12.1	4.25	11.8	- .11	2.52
5m64d4	3.70	10.3	3.75	10.4	+ .05	1.35
5m86t2	4.70	13.1	3.50	9.7	-1.20	25.53
6m	.20	0.6	.50	1.4	+ .30	150.00
6t	1.92	5.3	2.00	5.6	+ .08	4.17
0	.22	0.6	.50	1.4	+ .28	127.27
Total	35.98	100.00	36.00	100.00		

TABLE 70...continued

C.L.I. Rating	Planimeter Calculation Sq. Miles Within Township	Percent of Township	Visual Calculation by ¼ section allocation - raised to Sq. Miles	Percent of Township	Difference & % Difference between Planimeter & Visual Calculations in Sq. Mi. (Planimeter Reading used as Base)	
	(Sq. Miles)	(%)	(Sq. Miles)	(%)	(Sq. Mi.)	(%)
Forestry						
354W46W1	1.53	4.3	1.50	4.2	- .03	2.0
4m	13.86	38.5	13.00	36.1	- .86	6.2
4x	.20	.6	.25	.7	+ .05	25.0
4W86W2	3.83	10.6	4.00	11.1	+ .17	4.4
4W5336W2	2.34	6.5	2.00	5.6	- .34	14.5
4W634	4.88	13.6	4.25	11.8	- .63	12.9
4m832	.37	1.0	.50	1.4	- .13	35.1
4m86w2	1.49	4.1	2.25	6.3	- .76	51.0
4m85m2	3.64	10.1	4.00	11.1	+ .36	9.9
4m95m1	1.06	2.9	1.00	2.8	- .06	5.7
4w76w3	.10	.3	.25	.7	+ .15	150.0
4m77w3	1.75	4.9	1.75	4.9	----	

TABLE 70...continued

C.L.I. Rating	Planimeter Calculation Sq. Miles Within Township	Percent of Township	Visual Calculation by ¼ section allocation-raised to Sq. Miles	Percent of Township	Difference & % Difference between Planimeter & Visual Calculations in Sq. Mi. (Planimeter Reading used as Base)	
	(Sq. Miles)	(%)	(Sq. Miles)	(%)	(Sq. Mi.)	(%)
Forestry... cont'd.						
6w	.49	1.4	.25	.7	- .24	49.0
7w	.45	1.3	1.00	2.8	+ .55	122.2
Total	35.99	100.1	36.00	100.2		
Recreation						
4SKCA	1.25	3.5	1.25	3.5	----	
4VKCA	1.97	5.1	2.25	6.3	+ .28	14.2
4VQOE	2.36	6.6	2.75	7.6	+ .39	16.5
5SQCE	.74	2.1	.75	2.1	+ .01	1.4
5VCAP	3.41	9.5	3.50	9.7	+ .09	2.6
5VOEQ	6.26	17.4	4.50	12.5	-1.76	28.1
5VQAE	.58	1.6	1.00	2.8	+ .42	72.4
5VRQE	.14	.4	.25	.7	+ .11	78.6
5VOE	5.85	16.3	5.75	16.0	- .10	1.7

TABLE 70...continued

C.L.I. Rating	Planimeter Calculation Sq. Miles Within Township	Percent of Township	Visual Calculation by ¼ section allocation-raised to Sq. Miles	Percent of Township	Difference & % Difference between Planimeter & Visual Calculations in Sq. Mi. (Planimeter Reading used as Base)	
	(Sq. Miles)	(%)	(Sq. Miles)	(%)	(Sq. Mi.)	(%)
Recreation... cont'd.						
5VQOE	10.17	28.3	10.50	29.2	+ .33	3.2
6VPED	1.03	2.9	1.00	2.8	- .03	2.9
8	1.36	3.8	1.50	4.2	+ .14	10.3
Total	36.00	99.9	36.00	100.2		
Ungulates						
1Wmed	13.61	37.8	13.25	36.8	- .36	2.6
2Wmed	.82	2.3	1.25	3.5	+ .43	52.4
2Fme	14.97	41.6	14.75	41.0	- .22	1.5
3TFme	1.95	5.4	2.00	5.6	+ .05	2.6
3MFme	1.85	5.1	1.75	4.9	- .10	5.4
4TMFme	1.66	4.6	2.00	5.6	+ .34	20.5
5TMFme	.70	1.9	.75	2.1	+ .05	7.1
6MNme	.43	1.2	.25	.7	- .18	41.9
Total	35.99	99.9	36.00	100.2		

TABLE 70...continued

C.L.C. Rating	Planimeter Calculation Sq. Miles Within Township	Percent of Township	Visual Calculation by ¼ section allocation-raised to Sq. Miles	Percent of Township	Difference & % Difference between Planimeter & Visual Calculations in Sq. Mi. (Planimeter Reading used as Base)	
	(Sq. Miles)	(%)	(Sq. Miles)	(%)	(Sq. Mi.)	(%)
Waterfowl						
6TF	21.86	60.7	21.25	59.0	- .61	2.8
6TB	10.13	28.1	11.00	30.1	+ .87	8.6
7T	4.00	11.1	3.75	10.4	- .25	6.3
Total	35.99	99.9	36.00	99.5		

The calculation of acreage figure with the planimeter for the five capability classes in TP59R12W5 took 4 hours and 15 minutes. Visual interpretation and the transfer of the data to coding sheets took approximately 1 hour and 45 minutes. If the planimeter readings had been based on quarter section measurements it would have taken much longer. In large studies such as Lesser Slave Lake and Hinton-Yellowhead the planimeter method of measuring would be unrealistic.

The tests have shown that the method of measuring utilized in the Peers-Whitecourt study is subject to error. The technique developed for the Lesser Slave Lake and Hinton-Yellowhead studies would help to reduce this error,for all capability ratings excluding only those which occupied less than 10% of the quarter section would be recorded.

The most important aspect of analysis relates to the final output, and in the case of the Peers-Whitecourt Land Use Study the allocation of renewable resource uses. Within the study quarter sections were allocated to one of six land uses. This allocation was also applied to twsp. 59 range 12 west of 5th meridian through a manual over-lay process which was based on natural boundaries. The following results were obtained from the two methods of analysis.

TABLE 71

LAND ALLOCATION TP59R12W5

MANUAL OVERLAY AND COMPUTER PROCESSES

Land Use Categories	Overlay Process Manual Sq. Mi.	%	Quarter-Section Process Computer Sq. Mi.	%	Difference and % Difference between Overlay and Computer Process, (Overlay Process - used as Base) Sq. Mi.	%
Recreation	6.8	19.0	6.75	18.8	- .05	.7
Agriculture A	12.02	33.5	12.50	34.7	+ .48	4.0
Agriculture B	.20	.6	.00			100.0
Forestry A	1.72	4.8	1.75	4.9	+ .02	1.2
Forestry B	14.48	40.4	14.50	40.3	+ .02	.1
Forestry C	.60	1.7	.50	1.4	- .10	16.7
Total	35.83	100.0	36.00	100.1		

The results from both processes are surprisingly close. Agriculture B did not show up in the Quarter-Section process because it covered only 52 hectares (128 acres) in the overlay process and this was divided between several quarters.

The same type of analysis was conducted in the top half of TP54R14W5 and the bottom half of TP55R14W5 and the results obtained are shown in table 72.

As in the previous example the results from both processes are similar and land would be allocated almost identically by either method. At a township level the differences might seem significant; however, at the regional level the isolated differences in allocation would not affect broad land use patterns. The accuracy of the capability classifications and their boundaries must be remembered when they are utilized for land allocation. The detailed use of the data may not be justified in light of their origin.

The previous test on allocation at the quarter-section level has shown inaccuracies as the coding has tended to omit some of the small capability areas. To test if small units would provide more accuracy than the coding of quarter sections the capability classes for TP59-R12W5 were coded by legal subdivisions (40 acres units). The results are shown in table 73.

TABLE 72

LAND ALLOCATION TP54R14W5 AND TP55R14W5

MANUAL OVERLAY AND COMPUTER PROCESSES

Land Use Categories	Overlay Process Manual		Quarter-Section Process Computer		Difference and % Difference between Overlay and Computer Process (Overlay Process - used as Base)	
	Sq. Mi.	%	Sq. Mi.	%	Sq. Mi.	%
Recreation	.60	1.7	.50	1.4	- .10	16.7
Agriculture A	16.26	45.2	16.50	45.8	+ .24	1.5
Agriculture B	.58	1.6	.50	1.4	- .08	13.8
Forestry A	7.10	19.7	6.25	17.4	- .85	11.9
Forestry B	3.14	8.7	3.75	10.4	+ .61	19.4
Forestry C	8.32	23.1	8.50	23.6	+ .18	2.2
Total	36.00	100.0	36.00	100.0		

TABLE 73

LAND ALLOCATION (TP59-R12-W5)

BY LEGAL SUBDIVISIONS AND QUARTER SECTIONS - COMPUTER PROCESS

Land Use Categories	Quarter Section Units*		Legal Subdivision Units		Difference and % Difference between Quarter Sections and Legal Subdivisions**	
	Sq. Mi.	%	Sq. Mi.	%	Sq. Mi.	%
Recreation	6.25	17.4	5.63	15.6	+ .62	11.0
Agriculture A	11.50	31.9	11.00	30.6	+ .50	4.5
Agriculture B	.00		.00			
Forestry A	1.25	3.5	1.38	3.8	- .13	9.4
Forestry B	16.50	45.8	17.19	47.8	- .69	4.0
Forestry C	.50	1.4	.81	2.3	- .31	38.3
Total	36.00	100.0	36.01	100.1		

*Quarter section units allocated in this test of TP59R12W5 are different than those of previous test of this township because of changes in priorities.

**Allocation by legal subdivision has been used as the base as it is assumed that greater accuracy would be achieved at this level than by using quarter-sections.

The test between quarter sections and legal subdivisions indicates that there is little advantage to be gained by using the latter. Input by legal subdivision would take about four times longer to code than by quarter section and the minor increase gained in accuracy would not justify the additional time and expense.

The preceding portion of this study is a description of research that was undertaken to refine coding procedures and retrieval systems which would be utilized in handling C.L.I. capability data in the preparation of regional land use studies. Most of the deficiencies in the Peers-Whitecourt Land Use Study had hopefully been rectified and it would now be possible to commence preparation of the Hinton-Yellowhead Regional Land Use Study and the Lesser Slave Lake Regional Plan.

4. Lesser Slave Lake Regional Plan

In May 1970 the Lesser Slave Lake Special Area was established under a Federal/Provincial Special Area Agreement which was signed by the Federal Department of Regional Economic Expansion and the Provincial Human Resources Development Authority. Under the 'Special Areas' program the area was designated to receive special attention and funding to facilitate long term economic expansion and social adjustment.

> Funding in the Special Area was made available by the Federal and Provincial Governments in the form of grants and loans for three types of projects:
>
> 1. federal incentives grants and loans to industries - to encourage them to locate in the area and hence increase and diversify employment opportunities and utilize the existing resource base.
> 2. financial assistance for specific infrastructure projects in existing centres to allow them to attract and maintain industries and residents.
> 3. special social adjustment and vocational training programs to enable local people to take advantage of the newly created opportunities - emphasis was placed on increasing employment for local people, rather than attracting labour from outside the region.[190]

In response to these guidelines a wide variety of programs and projects was initiated within the study area. It soon became apparent that a broad planning framework which would place these in perspective was lacking, and it was therefore decided that a regional plan was required. However, Federal funding for projects and programs was immediately available and bureaucrats were not prepared to wait for the preparation of a regional planning strategy. A lack of planning was not going to stand in the way of development. Although it was not possible to influence the existing situation the Provincial Planning Branch felt that it was sufficiently important to prepare a regional plan which would assess the region's potential for development.

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[190] Alberta, Municipal Affairs, Planning Services Division, Regional Planning Section, Lesser Slave Lake Regional Plan, Historical and Physical Setting, April 1977, p. 1.

(a) Development of Provincial Priority Table

A major component of the regional plan would be an evaluation of the renewable resource potential and subsequent allocation of land based on this potential. The capability classifications of the Canada Land Inventory would serve as the primary source for resource information, and the Land Use Planning Data Bank of Alberta Municipal Affairs would provide the system by which the information could be manipulated.

The rural land use component of the Lesser Slave Lake Regional Plan, which covers 54,390 sq. km. (21,000 sq. mi.) in north-central Alberta, was designed to allocate land to its optimal, most productive or best renewable resource use based on biophysical criteria. The allocation is based on potential rather than on present land use so that the true value of the resource capability can be assessed. Present land uses are introduced at a later stage in the planning process where they could influence the final allocation or zoning map.

The allocation process is centred around the concept of establishing provincial priorities for resource utilization.

> The aim is to allocate land according to its potentially most productive use and in relation to the abundance or scarcity of each resource use potential in the province. This provincial perspective is extremely important when dealing with a specific region, which will certainly be atypical of the province as a whole, as scarcity of resources should not be judged on a sub-regional or local basis. Thus, the value of each site or land unit in relation to all other areas in the province must be kept in mind.'[191]

In the Peers-Whitecourt Land Use Study priorities for allocation had been developed around local priorities which did not deliberately represent a provincial perspective. This isn't to say that they were inappropriate in a provincial context, it is just that local priorities were stressed whether or not they were also provincial priorities. However, the Lesser Slave Lake Region could not be dealt with in isolation, and it was considered extremely important to be able to compare the resource potential of the region with the rest of Alberta. Local and regional priorities would be considered at a latter stage in the planning process.

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[191] Alberta, Municipal Affairs, Research Planning Section, Provincial Planning Branch, Allocation of Land According to Renewable Resource Potential, Lesser Slave Lake Regional Plan, Rural Land Use Study, Section III, April, 1974, p. 2.

The first step in the preparation of a provincial perspective or priority table was the input of the capability classification information on a quarter section basis into the Land Use Planning Data Bank. Once the information was coded it was then possible to test and manipulate it in the preparation of the priority table. Another important step was the quantification of the forestry and agriculture capability classification.

Actually the forestry classification was the only one in which the capability classes had been assigned productivity indices, but because the classification often contained complex ratings it was necessary to determine average potential productivity ranges for quarter section units. Productivity figures for each land unit were derived by multiplying the average potential productivity for each land type present by the proportion of that type of land in the quarter section, summing these values and dividing by 100 (quarter sections are coded by 1/10 integrals) to give average potential timber production per acre per annum. The figures were then expanded to provide average potential per quarter section.

Example: For a quarter section with 70 percent class 3,20% class 4 and 10% class 7 the total potential productivity would be:

*(80 x 70) + (60 x 20) + (5 x 10) = 6,850/100 = 68.5 x 160 = 10,960 cubic feet of timber per annum.

*class 3 - productivity range 71 - 90 cubic feet per acre per annum (Median 80 cubic feet).

The values determined through this process were categorized into ranges which reflected the relative productivity or value of the land and its suitability for timber production. (see table 74).

The figures in the following categories indicate the percentage of the Lesser Slave Lake Region within each. The information was also used in the preparation of a Potential Forest Production map which illustrated the categories at a quarter-section level. This map is similar to the original Forestry Capability Classification map except that it shows the data in terms of potential production (cubic feet of timber) per quarter section.

TABLE 74

POTENTIAL TIMBER PRODUCTION CATEGORIES

Potential Production Cubic Ft. of Timber Per Quarter Section	C.L.I. Capability Class Equivalent	Relative Value or Potential for Commercial Timber Production
11200 - 12800	100% class 3 down to 50% 3 + 50% 4	good
8000 - 11199	50% 3 + 50% 4 down to 50% 5 + 50% 5	moderate to good
6400 - 7999	100% 5 down to 50% 6 + 50% 7	fair to moderate
2000 - 6399	100% 5 down to 50% 6 + 50% 7	poor to fair
1 - 19999	less than 50% 6 + 50% 7	no value

Source: Lesser Slave Lake Regional Plan, Allocation of Land According to Renewable Resource Potential, 1974.

TABLE 75

PROPORTION OF LESSER SLAVE LAKE STUDY AREA IN EACH POTENTIAL FORESTRY PRODUCTIVITY CATEGORY

Cubic Feet of Timber	No. of Quarter Sections	Percent of all Quarter Sections
11200 - 12800	1,943	2.3
8000 - 11999	27,395	32.3
6400 - 7999	12,963	15.3
2000 - 6399	28,604	33.8
1 - 1999	9,936	11.7
Water	3,147	3.7
Unclassified	720	0.9

Source: Lesser Slave Lake Regional Plan, Allocation of Land According to Renewable Resource Potential, 1974.

In the development of the priority table it was considered important to be able to compare agriculture with forestry for it was anticipated that many areas especially in the northern part of Alberta would have similar potential for both uses. Unlike the forestry classification, the agricultural one did not include a range of yields per acre. A series of possible ranges of wheat production per acre per year had been developed by the Alberta Soil Survey in their Soil Rating Schedule and these were then related to the Soil Capability Classification for Agriculture.(see table 76)

Productivity for each quarter section was then determined through the same process utilized in the Forestry Capability Classification.

Example: For a quarter section with 60% class 1 soils, 30% class 3 and 10% class 6 the productivity would be:

(33 x 60) + (18 x 30) + (3 x 10) = 2550/100 = 25.5 x 160 =

4080 bushels of wheat per annum per quarter section.

The productivity figures calculated by this method were categorized into ranges and the information was illustrated on a quarter section basis in a Potential Agricultural Production map. This map paralleled the one prepared for forestry and they both presented

TABLE 76

SOIL CAPABILITY FOR AGRICULTURE
POTENTIAL PRODUCTIVE CAPACITY

C.L.I. Class	Potential Production Bushels of Wheat Per Acre Per Annum**	Median
1	28 - 38	33
2	20 - 38	24
3	16 - 20	18
4	12 - 16	14
5*	6 - 12	9
6*	0 - 6	3
7*	0	0
0*	0	0

*Not suitable for field crop production.

**Based on Alberta Soil Survey Ratings (see table 44)

Source: Lesser Slave Lake Regional Plan, Allocation of Land According to Renewable Resource Potential, 1974.

an opportunity for the visual interpretation and evaluation of the classifications by quarter-sections. The production categories for agriculture are shown in table 77.

The quantification of the agriculture and forestry classifications was a major step in the development of a priority table. Unfortunately the other classifications did not lead themselves to such analysis.

> Having provided a detailed description and explanation of the physical resources and potential for various renewable resource land uses in the Lesser Slave Lake area, it is necessary to determine a method whereby potential for these different land uses can be compared and evaluated in relation to one another within a single land unit or area. Basically this means deciding which land use would be most productive, valuable or beneficial in each area and hence which level of potential for one of these specific uses is more valuable to or valued by Albertans. Is a piece of land more valuable if during one year it can produce 300 bushels of wheat, 5000 cubic feet of timber, provide habitat for two elk or fifty ducks or provide twenty user-days of recreational experience.[192]

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[192] Ibid., p. 64.

TABLE 77

POTENTIAL AGRICULTURAL PRODUCTION CATEGORIES

Potential Production Bushels of Wheat Per Quarter Section	C.L.I. Capability Class Equivalent	Relative Potential Value for Agriculture in Alberta
3840 - 5280	100% class 1 down to 100% class 2	very good to excellent arable
3360 - 3839	100% class 2 down to 50% class 2 + 50% class 3	good arable
2560 - 3359	50% class 2 + 50% class 3 down to 50% class 3 + 50% class 4	fairly good arable
1840 - 2559	50% class 3 + 50% class 4 down to 50% class 4 + 50% class 5	fair arable or good pasture
1440 - 1839	50% class 4 + 50 class 5 down to 100% class 5	poor arable or fairly good pasture
1 - 1439	100% class 5 to 100% class 6	fair to poor pasture
0	class 7 or class 0	no agricultural potential

Source: Lesser Slave Lake Regional Plan, Allocation of Land According to Renewable Resource Potential, 1974.

The difficulty of establishing monetary values for wildlife and recreation has been documented numerous times. Analysis in the case of the C.L.I. classifications is even more difficult because carrying capacity values have not been provided. Much of their value lies in the provision of intangible social and aesthetic benefits.

In the Lesser Slave Lake Regional Plan a method was developed to provide monetary values for agriculture and forestry for it would be between these two land uses that the greatest conflict would occur. Based on the average potential production figures established for agriculture and forestry, monetary values were developed. These were based on the average price of wheat and timber (lumber) paid to the producer in Alberta over the five year period 1968 - 72.

> The average price of wheat per bushel, paid to the farmer at elevators in Alberta was $1.31. The average price of coniferous lumber per cubic foot paid to the mill owner at the sawmill in Alberta was $0.398. Thus, the relative value of a bushel of wheat to a cubic foot of timber was 1:3.296 (or 100 bushels of wheat had a marketable value equivalent to 330 cubic feet of timber).[193]

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[193] Ibid., p. 69.

> This method of comparison assumes equivalent production costs for timber and wheat per quarter section on land unit. Since the size of management units, level of technology and investment within both land use types can vary so widely, no standard production cost can be assigned to either land use. By using an average price over a five-year period it is hoped to minimize the effect of short term temporary price fluctuations which may distort the general price trend.[194]
>
> Since the returns cited will be 'gross' returns rather than 'net' returns (i.e., price minus the production costs of capitol, labour and land), monetary values have not been inserted in the priority table developed for land allocation. All comparisons are carried out using the ratio calculated for bushels of wheat in relation to cubic feet of timber (1:3.296).[195]

The value of production in monetary terms was calculated by multiplying the average production of wheat or timber per quarter section per year by the average market value of wheat or timber:

Example: A quarter section of land which is 100% class 2 capability for agriculture (3840 bushels per annum) would have a monetary return of 3840 x 1.312 = $5,038. A quarter section which is 100% class 3 capability for forestry (12,800 cubic of timber per annum) would have a monetary value of 12,800 x 0.398 = $5,094.

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[194] _Ibid._, p. 69.

[195] _Ibid._, p. 72.

> Since the estimates of productive capacity and monetary return are both based on averages the direct comparison of values would be inappropriate, indicating a level of accuracy in the figures which is not justifiable. Therefore, potential production has been compared over a range of values.[196]

In many cases the values for both agriculture and forestry are almost equal, and because they are exclusive uses these quarter sections are said to be in conflict. In conflict areas the allocation of land to either agriculture or forestry is left to a later stage in the planning process when such factors as vegetative cover, present land use, disposition, size of viable management units, accessibility, etc., have been considered.

The conflict categories that have been established are illustrated in table 78.

In the Lesser Slave Lake study area land has been allocated at the quarter-section level to one of the five renewable resource uses (agriculture, forestry, recreation, ungulates, waterfowl) or to a conflict category as indicated in the previous table through a priority system. "Such a system will allocate the land to one specific use through a predetermined ordering of the capability levels for each potential use, based on the objective of maximizing the

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[196] Ibid., pp. 75 - 76.

TABLE 78

CONFLICT CATEGORIES FOR AGRICULTURAL AND FOREST LAND USE

Potential Wheat Production Per Quarter Section (bushels/annum)	Average Monetary* Return Per Quarter Section Per Annum in Dollars (1968 - 72 Average)	Potential Timber Production Per Quarter Section (cu. ft./annum)
3,360 - 3,839 =	$ 4,408 - 5,037 4,457 - 5,094 =	11,200 - 12,800
2,880 - 3,359 =	3,779 - 4,407 3,821 - 4,456 =	9,600 - 11,199
2,560 - 2,879 =	3,359 - 3,778 3,184 - 3,820 =	8,000 - 9,599
1,840 - 2,559 =	2,414 - 3,358 2,547 - 3,183 =	6,400 - 7,999
1,440 - 1,839 =	1,889 - 2,413 1,910 2,546 =	4,800 - 6,399

*Based on monetary return of $1.312 per bushel of wheat and $0.398 per cubic foot of timber.

Source: Lesser Slave Lake Regional Plan, Allocation of Land According to Renewable Resource Potential, 1974.

returns or benefits-economic, social and aesthetic - to the people of Alberta from the total provincial land resource in relation to the supply of land of each quality and the demand for each renewable resource." [197]

Agriculture and forestry have been compared in monetary terms but recreation, ungulates and waterfowl have been incorporated into the system on the basis of protecting a valuable and scarce resource with economic and social values. The level of demand was also considered but it was not quantified and, therefore, did not play a major role in the decision process.

(b) The Provincial Priority Table and Land Allocation

The priority table illustrated in the following table allocates land to its potentially most productive or valuable renewable use. The table contains 25 levels of assignment. The second column indicates the renewable resource use to which the land is assigned at that level. The third column indicates the C.L.I. class or classes necessary for allocation at the indicated level, and the fourth indicates ranges for agriculture and forestry in bushels of wheat and cubic feet of timber.

In the allocation of agriculture or forestry the capability of the total land surface of the quarter section is considered. The

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[197] *Ibid.*, p. 78.

TABLE 79

ALLOCATION OF LAND BY RENEWABLE RESOURCE (PRIORITY TABLE)

Level of Assignment	Assigned Renewable Resource Use	C.L.I. Capability Class Equivalent	Production Per Quarter Section Per Year (Agriculture - bushels of wheat; Forestry - cubic feet of timber)
1	RECREATION	Class 1 or 2	
2	WATERFOWL	1, 2 or 3 Staging Area or 3 Migration Stop	
3	UNGULATES	1 or 2 Wintering Range	
4	AGRICULTURE	100% 1 down to 100% 2	3840 - 5280 bushels
5	AGRICULTURE or FORESTRY	100% 2 down to 50% 2 + 50% 3 and 100% 3 down to 50% 3 + 50% 4	3360 - 3839 bushels and 11200 - 12800 cu. ft
6	AGRICULTURE	100% 2 down to 50% 2 + 50% 3	3360 - 3839 bushels
7	FORESTRY	100% 3 down to 50% 3 + 50% 4	11200 - 12800 cu. ft
8	RECREATION	3	
9	AGRICULTURE or FORESTRY	50% 2 + 50% 3 down to 100% 3 and 50% 3 + 50% 4 down to 100% 4	2880 - 3359 bushels and 9600 - 11199 cu. ft
10	AGRICULTURE or FORESTRY	100% 3 down to 50% 3 + 50% 4 and 100% 4 down to 50% 4 + 50% 5	2560 - 2879 bushels and 8000 - 9599 cu. ft
11	AGRICULTURE	50% 2 + 50% 3 down to 50% 3 + 50% 4	2560 - 3359 bushels
12	FORESTRY	50% 3 + 50% 4 down to 50% 4 + 50% 5	8000 - 11199 cu. ft
13	RECREATION	4 shoreline or 4 site - specific upland (intensive use)	
14	UNGULATES	3 Wintering Range	
15	AGRICULTURE or FORESTRY	50% 3 + 50% 4 down to 50% 4 to 50% 5 and 50% 4 + 50% 5 down to 100% 5	1840 - 2559 bushels and 6400 - 7999 cu. ft
16	AGRICULTURE	50% 3 + 50% 4 down to 50% 4 + 50% 5	1840 - 2559 bushels
17	FORESTRY	50% 4 + 50% 5 down to 100% 5	6400 - 7999 cu. ft
18	RECREATION	4 upland (extensive use) 5 shoreline or 5 site specific upland (intensive use)	
19	AGRICULTURE or FORESTRY	50% 4 + 50% 5 down to 100% 5 and 100% 5 down to 50% 5 + 50% 6	1440 - 1839 bushels and 4800 - 6399 cu. ft
20	AGRICULTURE	50% 4 + 50% 5 down to 100% 5	1440 - 1839 bushels
21	FORESTRY	100% 5 down to 50% 6 + 50% 7	2000 - 6399 cu. ft
22	WATERFOWL	1 or 2	
23	UNGULATES	1 or 2	
24	NO USE ASSIGNED	0 (organic soil	no productive capacity
25	FORESTRY	Less than 50% 6 + 50% 7	1 - 1999 cu. ft

Source: Alberta, Department of Municipal Affairs, Lesser Slave Lake Regional Plan, Allocation of Land According to Renewable Resource Potential, 1974.

limitations associated with the classes in these two classifications are not considered. With recreation, ungulates and waterfowl only 10 percent of the quarter section needs to be rated at the level shown in the third column of the priority table to be allocated. The higher capability recreation and wildlife areas are scarce in Alberta and their natural boundaries often cut across quarter sections. Allocation at the 10 percent level of detail, thus, ensures that the high capability areas such as class 1 and 2 beaches and 1W river valleys are not ignored.

The relative value or importance of the land at each priority level is indicated in table 80.

> One striking feature of the priority system is that it assigns land units to a single use. The priority table attempts to depict the highest capability or optimal use of each land unit, based on a provincial perspective in terms of the relative supply of the various capabilities of land for each use and the level of demand for the 'products' provided by each renewable resource use. The system is designed to allocate land to its 'prime' use and only in the cases of equal potential for forestry and agriculture (conflict levels 5, 9, 10, 15 and 19) is the allocation to a single use postponed until other factors besides inherent physical characteristics can be considered. [198]

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[198] Ibid., p. 89.

TABLE 80

RELATIVE VALUE OF ASSIGNED USE FOR EACH PRIORITY LEVEL

Excellent	Good	Moderate	Fair	Poor	No Value
1* Rec.**	5 Conflict (Ag/For)	9 Conflict 10 (Ag/For)	15 Conflict (Ag/For)	19 Conflict (Ag/For)	24 organic soils
2 Waterfowl	6 Agric.	11 Agric.	16 Agric.	20 Agric.	25 Forestry
3 Ungulates	7 Forestry	12 Forestry	17 Forestry	21 Forestry	
4 Agric.	8 Rec.	13 Rec.	18 Rec.		
	14 Ungulates				
	22 Waterfowl				
	23 Ungulates				

*Priority Level

**Renewable Resource Use

Source: Lesser Slave Lake Regional Plan, Allocation of Land According to Renewable Resource Potential, 1974.

Of course it has been argued that quarter sections should have been assigned a number of uses rather than a single use. However, in reality most land use in Alberta is single purpose. There may be secondary uses such as ungulate habitat, but each quarter section usually has a primary use such as farming, lumbering or recreation. It must also be remembered that the priority table is intended to show 'optimum' potential. Multiple or secondary uses are considered later in the planning process.

Numerous assumptions were made in developing the provincial perspective upon which the priority table was based. This was necessary because detailed documentation on supply and demand for renewable resources in Alberta was not available. The priority table is intended to reflect a provincial perspective so that it can be utilized anywhere in the province. It was not designed specifically for the Lesser Slave Lake study.

An explanation of the provincial perspective and the rationale for each level of assignment in the priority table are detailed in the Lesser Slave Lake Regional Plan, Allocation of Land According to Renewable Resource Potential between pages 91 and 127.

One of the major concerns over the use of the priority table was that high capability lands for a particular use might be exempted by allocation to another high use. A class one area for ungulates might also be a class 1 area for waterfowl. In order to identify and document this concern the number of quarter sections assigned at each level in the priority table were compared to the number of quarter sections which would satisfy the criteria for assignment at each level. For example 2,197 quarter sections satisfied level 13 recreation, but only 1,210 of these were assigned at this level.

The percent of the total not assigned is 4.6 or less between assignment levels 1 and 8. This indicates that there are no major conflict problems between the high renewable resource use assignments. The percentages are of course quite high in some of the lower assignments where large areas of class 1 and 2 waterfowl and ungulate habitat have been assigned to agriculture or forestry.

In total 4,782 quarter sections were assigned equal levels for both agriculture and forestry. In these cases the effects of allocating all quarter sections to either agriculture or forestry have been determined.

> Example: At level 15, 1,747 quarter sections were identified as having equal potential for forestry and agriculture.
>
> At level 16, 1,915 quarter sections were assigned to agriculture. If all the quarter sections in conflict at level 15 were also assigned to agriculture, a total of 3,662 out of a possible 11,745 quarter sections which satisfy the criteria required to assign land to agriculture at this level would be assigned. Thus, at present 16.3% of all quarter sections satisfying the required criteria are assigned at level 16 but if all conflict areas were included 31% could be assigned.
>
> At level 17, 8,747 quarter sections were assigned to forestry. If all the quarter sections in conflict at level 15 were assigned to forestry rather than agriculture, this would be a total of 10,494 out of a possible 12,963 quarter sections which satisfy the criteria required to assign land to forestry at this level. Thus, at present, at level 17, 67.5% of all eligible quarter sections are assigned.[199]

The relationships between number of quarter section assigned and number satisfying criteria for each level of assignment are illustrated in table 81.

In summary, land was allocated as indicated in table 82 to the following renewable uses within the Lesser Slave Lake study area.

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[199] Ibid., p. 138.

TABLE 81

RELATIONSHIP BETWEEN NUMBER OF QUARTER SECTIONS ASSIGNED AT EACH PRIORITY LEVEL AND NUMBER SATISFYING THE CRITERIA FOR ASSIGNMENT AT EACH LEVEL: LESSER SLAVE LAKE STUDY AREA

Assignment Level	Assigned Renewable Resource Use (and Related Value	a) Number of quarter sections satisfying criteria for assignment	b) Number of quarter sections assigned	c)* Plus Conflict	d) Percent of Total Assigned	e) * Plus Conflict	f) Percent of Total Not Assigned	g) * Plus Conflict
1	RECREATION (Excellent)	146	146		100.0		-	
2	WATERFOWL (Excellent)	645	645		100.0		-	
3	UNGULATES (Excellent)	2,003	2,003		100.0			
4	AGRICULTURE (Excellent)	551	550		100.0			
5	CONFLICT (Good)		3					
6	AGRICULTURE (Good)	1,299	1,290	1,293	99.3	99.5	0.7	0.5

TABLE 81...continued

Assignment Level	Assigned Renewable Resource Use (and Related Value)	a) Number of quarter sections satisfying criteria for assignment	b) Number of quarter sections assigned	c) * Plus Conflict	d) Percent of Total Assigned	e) * Plus Conflict	f) Percent of Total Not Assigned	g) * Plus Conflict
7	FORESTRY (Good)	1,943	1,926	1,929	99.1	99.3	0.9	0.7
8	RECREATION (Good)	524	500		95.4		4.6	
9/10	CONFLICT (Moderate)		1,418 608 810					
11	AGRICULTURE (Moderate)	4,931	3,414	4,832	69.2	98.0	30.8	2.0
12	FORESTRY (Moderate)	27,395	21,908	23,326	80.0	85.1	20.0	14.9
13	RECREATION (Moderate)	2,197	1,210		55.1		44.9	

TABLE 81...continued

Assignment Level	Assigned Renewable Resource Use (and Related Value)	a) Number of quarter sections satisfying criteria for assignment	b) Number of quarter sections assigned	c) * Plus Conflict	d) Percent of Total Assigned	e) * Plus Conflict	f) Percent Total Not Assigned	g) * Plus Conflict
14	UNGULATES (Good)	1,965	903		46.0		54.0	
15	CONFLICT (Fair)		1,747					
16	AGRICULTURE (Fair)	11,748	1,915	3,662	16.3	31.2	83.7	69.8
17	FORESTRY (Fair)	12,963	8,747	10,494	67.5	81.0	32.5	19.0
18	RECREATION (Fair)	9,026	3,120		34.6		65.4	
19	CONFLICT (Poor)		1,614					

TABLE 81...continued

Assignment Level	Assigned Renewable Resource Use (and Related Value)	a) Number of quarter sections satisfying criteria for assignment	b) Number of quarter sections assigned	c)* Plus Conflict	d) Percent of Total Assigned	e)* Plus Conflict	f) Percent Total Not Assigned	g)* Plus Conflict
20	AGRICULTURE (Poor)	14,919	2,546	4,160	17.1	27.9	82.9	72.1
21	FORESTRY (Poor)	28,604	17,632	19,246	61.6	67.3	38.4	32.7
22	WATERFOWL (Good)	821	344		41.9		58.1	
23	UNGULATES (Good)	1,923	23		1.2		98.8	
24	NO USE	4,674	4,674					
25	FORESTRY (No Timber Use)	9,936	3,251		32.7		67.3	

*Columns c), e), and g) indicate the maximum possible assignment to agriculture and forestry at each level, if lands in 'conflict' for agriculture and forestry at the corresponding level were added to each of these uses in turn, exclusively.

Source: Lesser Slave Lake Regional Plan, Allocation of Land According to Renewable Resource Potential, 1974.

TABLE 82

RENEWABLE RESOURCE ALLOCATION
LESSER SLAVE LAKE STUDY AREA

Resource Use	No. of Quarter Sections	Percent of Area
Agriculture	9,715	12.64
Forestry	53,464	69.56
Conflict (Ag/For)	4,782	6.22
Recreation	4,976	6.47
Ungulates	2,929	3.81
Waterfowl	989	1.29
Total	76,855	99.99

The development of the priority table and its utilization in the Lesser Slave Lake Regional Plan was a major advancement in the generation of new techniques for the utilization of the Canada Land Inventory. The priority table, however, could not have been created without the Land Use Planning Data Bank. The priority table was subject to extensive testing and several variations were prepared before the final 25 levels of assignment were determined. The computer system granted the flexibility that was necessary for the rapid and accurate manipulation of information. Manual manipulation of the data would have been impossible.

(c) Comments and Evaluation

The release of the methodology report, Allocation of Land According to Renewable Resource Potential, and the accompanying maps for the

Lesser Slave Lake Region in April 1974 initiated considerable discussion within the Alberta Government. The rural land use component of the Lesser Slave Lake Regional Plan had been initiated in 1970 and many people had forgotten about it. Resource personnel within the Government were more concerned with the Foothills Resource Allocation Study which was receiving considerable publicity. They knew that Municipal Affairs was working with the computer but they were not prepared for the allocation map and provincial priority table that were being developed.

The immediate reaction by the resource agencies was similar to that encountered with the release of the Peers-Whitecourt Land Use Study. Municipal Affairs should be dealing with urban communities and not getting involved with resources. Alberta Lands and Forests was quick to point out that most of the Lesser Slave Lake area was Crown land and regional planners from Municipal Affairs had no business in assessing the renewable resource base.

The majority of comments received on the methodology were extremely useful to the further development of the system. As anticipated some of the comments referred to the use of the quarter section as the unit of input. The methodology report explained in considerable detail the reasons for using the quarter section and emphasized that the unit was ideally suited as input and that final land allocations would be made on much larger units. "The problemsinherent in using C.L.I. information alone as a basis for land use still maintain that C.L.I. information is not sufficiently accurate to be applied at the quarter section level."[200]

> There are two general comments to be made, both of which have been made before. The first one relates to the use of C.L.I. data on a quarter section level. All of the considerations in favour of this small areal unit are of a convenience nature, which should not take precedence over the limiting factors of the basic data.[201]

> As the basic data for much of the area is skimpy, to say the least, then one becomes concerned when interpretative maps present this information on a quarter-section basis. Admittedly it is clearly stated in the text that the quarter section is not a relevant basis for land use planning and that individual quarters should not be considered in isolation. However, this qualification appears on page 81 of the text. In our opinion this should appear in bold print in the forward or in the introduction.[202]

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[200] Alberta Lands and Forests, correspondence from G. R. Kerr, Director of Fish & Wildlife to N. Dant, Director Provincial Planning, Municipal Affairs, May 22, 1974.

[201] Alberta Lands and Forests, correspondence from J. R. Harrower, Director Technical Division to R. G. Steele, Deputy Minister, Lands and Forests, June 6, 1974.

[202] Alberta Research Council, correspondence from R. Green, Chief Earth Sciences Branch to S. J. Collins, Provincial Planning, Municipal Affairs, May 31, 1974.

The previous comments were received from resource agencies who deal with specific types of data and feel that the C.L.I. is too generalized for their needs. Comments from one of the users of the information who requires generalized data were quite different.

"We especially like your justification for using the quarter section as the basic areal unit: providing its limitations are realized this seems to be the most logical building block for any coarse allocation system." [203]

The attempt by Municipal Affairs to quantify the agriculture classification so that it could be compared to forestry generated considerable debate.

> A direct interpretation of the Soil Rating System into C.L.I. Soil Capability may be somewhat subjective, since the Rating System is based on wheat yields (Storie System) and the Soil Capability system is based on whether or not a particular soil will sustain a wide variety or narrow variety of crops. It is questionable whether the Slave Lake area should be rated on the basis of wheat production since most of the area is not suitable for this cereal crop. [204]

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[203] Battle River Regional Planning Commission, correspondence from R. H. Riddett to N. Dant, Director, Provincial Planning, Municipal Affairs, June 5, 1974.

[204] Alberta Research Council, op. cit., p. 2.

> I object to using the production of wheat as an indicator of land's capability for agriculture; a downward bias is thereby inflicted due to the short growing season. Intensive operations (dairying for example) can function viably on class 4 and 5 land. As well, crops with a shorter frost free period (barley, oats) can be grown here. Oilseeds should also be given consideration.[205]

> The criteria of bushels of wheat per quarter section leaves a lot to be desired. The C.L.I. soil capability for agriculture is based on limitations to yields of common crops. Once yields are attached to these classes, an economic evaluation is made. We would highly recommend that barley be used as the arable crop rather than wheat.[206]

> The assumption that production costs are equivalent for timber and wheat per land unit is doubtful, as is the assumption that in order to stay in business the producer must achieve a reasonable return. A further complication results from the use of wheat as a common denominator for all agricultural values, especially when wheat production is not too likely to be successful in most of the study area.[207]

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[205] Alberta, Agriculture, correspondence from J. Knapp, Resource Economics Branch to S. J. Collins, Provincial Planning, Municipal Affairs, May 2, 1974.

[206] Alberta, Agriculture, correspondence from A. W. Goettel, Head, Soils Branch to S. J. Collins, Provincial Planning, Municipal Affairs, May 21, 1974.

[207] Alberta, Lands & Forests, correspondence from G. M. Smart, Head, Forest Land Use Branch to N. Dant, Director, Provincial Planning, Municipal Affairs, June 7, 1974.

These comments on the attempt to quantify agriculture and then compare it to forestry in terms of monetary returns summarize the major criticism of the study. If more time had been available additional indicators other than wheat would have been investigated. The comments point out that additional research is required if the quantification of agriculture is to be accepted.

The Canadian Wildlife Service expressed concern over the allocation of waterfowl areas.

> The main objection I have to the present plan is that it tends to over-emphasize the value of migration and staging areas in relation to habitat rated solely on its waterfowl production capability (class 1 and 2). Of course I am pleased that classes 1S, 2S, 3S and 3M were given a very high level of assignment but at the same time disappointed with the position of classes 1 and 2. A priority assignment which designates a class 5 agriculture or class 6 forestry over a class 1, 2 or 3 waterfowl area is quite unacceptable. Since class 3 is still considered a good waterfowl habitat it should receive a position on your assignment list.[208]

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[208] Environment Canada, Canadian Wildlife Service, correspondence from C. D. Schick to S. J. Collins, Provincial Planning, Municipal Affairs, May 21, 1974.

The Fish and Wildlife Divisions of Alberta Lands and Forests expressed concern over the lack of fisheries information and the downgrading of ungulates and waterfowl.

> The omission of fisheries information is considered serious by our Division. Although it is a water based resource, the use of the land in these various watersheds has a direct bearing on the water quality and quantity supporting this resource. Therefore, the fisheries resource has to be considered when allocating uses to land...In general, the only lands allocated to ungulates are winter ranges and to waterfowl, migration and staging areas. Admittedly, these are considered to be key areas to these wildlife groups. However, the practice of allocating lands rated 1 and 2 for ungulates or waterfowl to agriculture or forestry with corresponding 5 and 6 ratings is completely unacceptable from our viewpoint. These represent the prime breeding areas...If a large portion of these prime areas cannot be maintained the key winter ranges and staging areas become rather insignificant.[209]

Fisheries information was not included in the allocation process for several reasons. Complete data were not available for the Lesser Slave Lake area, and the reliability of these which were available had not been proven. Indirectly angling potential was covered by the Recreation capability classification. The allocation of much of the Swan Hills to extensive recreation would help to maintain the fishery resource in that area.

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[209] Alberta, Lands and Forests, Fish & Wildlife Division, op. cit., pp. 1 and 2.

One can certainly argue that high capability habitat areas for waterfowl and ungulates should have been emphasized in the allocation process. However, realistically it would not be accepted as most of these areas were committed to other land use activities. Habitat areas would have to be considered as secondary and hopefully compatible land uses. The designation on the allocation map of 'key' areas for ungulates and waterfowl was a major step in renewable resource analysis. Previous studies including the Peers-Whitecourt Land Use Study had usually designated wildlife uses as being secondary.

In addition to those comments that have been noted numerous favourable and encouraging comments were received. "The allocation of land on the basis of resource capability does provide a sound framework for land use planning, and the plan clearly achieves its objectives in this respect."[210]

> In general, the maps produced for Section III appear to conform to our own general opinion. It has been proposed to revert several townships in the Snipe Lake and Enilda areas from Yellow Zone to Green Zone. The resource allocation map backs up our recommendations in the Snipe Lake area while in the Enilda area the townships of concern are divided between allocations for forestry, forestry or agricultural use (conflict areas) and the allocation for agricultural use.[211]

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[210] Alberta, Environment Conservation Authority, correspondence from B. Sadler to H. L. Hogge, June 5, 1974.

[211] Alberta, Lands and Forests, correspondence from H. R. Winn, Forest Superintendent, Slave Lake to N. Dant, Director, Provincial Planning, Municipal Affairs, May 21, 1974.

"Apart from suggestions that the forestry-agriculture economic comparison is subject to criticism, I do not substantially disagree with the priority table used for preliminary allocation of land and the allocations themselves seem to be reasonable for the most part." [212]

> The report indicates the beginning, at a province wide scale, of a generalized resource allocation model. This level of study should be continued to cover the remainder of the province. [213]

"Because of the large size of our regional planning area and its largely rural nature, we feel that this technique will be of considerable use to us in developing a regional plan; we are therefore anxious to see the technique become accepted by the various provincial resource management agencies with whom we must work in preparing the regional plan." [214]

> We found the conceptual framework within which the analyses were done to be in complete agreement with our philosophy of a systematic approach to natural resource planning based on 4 levels of planning: provincial, regional, management and operational. There appears to be no serious concern about how the Canada Land Inventory data were

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[212] Alberta, Lands and Forests, op. cit., correspondence from G. M. Smart.

[213] Alberta, Lands and Forests, correspondence from T. A. Drinkwater, Director of Parks to N. Dant, Director, Provincial Planning, Municipal Affairs, June 6, 1974.

[214] Peace River Regional Planning Commission, correspondence from B. Buholzer to S. J. Collins, Provincial Planning, Municipal Affairs, May 21, 1974.

> utilized in your analyses. Your use of a systematic and documented approach for storing, manipulating and retrieving the information is most encouraging. Certainly your approach provides the flexibility required in the use of a priorities system. This is a very welcome feature if we are to embark on such a system being used on provincial and regional levels and having inputs from many groups and agencies.[215]

"I realize that it is an impossible task to produce a plan which will satisfy everyone, but whatever the result, you will have made a significant contribution to bringing land use planning and resource allocation in Alberta out of the dark ages."[216]

5. Hinton-Yellowhead Regional Land Use Study

During the preparation of the Lesser Slave Lake Regional Plan another team of regional planners from Municipal Affairs was preparing a similar study for the Hinton-Yellowhead region of Alberta. The methodology utilized was identical to that of the rural land use component of the Slave Lake study, and the Provincial Priority Table was used in developing the renewable resource allocation. Through the use of the priority table the renewable resource potential of both study areas can be easily compared.

In table 83 the number of quarter sections assigned at each level of the priority table and the number of quarter sections which would satisfy the criteria for assignment at each level are indicated.

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[215] Alberta, Environment, correspondence from H. W. Thiessen, Assistant Deputy Minister, Environmental Co-ordination Service to N. Dant, Director, Provincial Planning, Municipal Affairs, May 31, 1974.

[216] Environment Canada, op.cit.

TABLE 83

RELATION BETWEEN NUMBER OF QUARTER SECTIONS ASSIGNED AT EACH PRIORITY LEVEL AND NUMBER SATISFYING THE CRITERIA AT EACH LEVEL
HINTON-YELLOWHEAD STUDY AREA

Assignment Level	Assigned Renewable Resource Use	No. of ¼-sections satisfying Criteria	No. of ¼-sections Assigned	Plus * Conflict	Percent of Total Assigned	Plus * Conflict	Percent of total not Assigned	Plus * Conflict
1	RECREATION (Excellent)	21	21		100.0		0.0	
2	WATERFOWL (Excellent)	0	0		100.0		0.0	
3	UNGULATES (Excellent)	1,503	1,503		100.0		0.0	
4	AGRICULTURE (Excellent)	35	35		100.0		0.0	
5	CONFLICT (Good)	9	9					
6	AGRICULTURE (Good)	48	39	48	81.3	100.0	18.7	0.0
7	FORESTRY (Good)	590	568	577	96.3	97.8	3.7	2.2
8	RECREATION (Good)	192	174		90.6		9.4	
9 10	CONFLICT (Moderate)	100	100					
11	AGRICULTURE (Moderate)	285	119	219	41.8	76.8	58.2	23.2
12	FORESTRY (Moderate)	9,451	8,973	9,073	94.9	96.0	5.1	4.0
13	RECREATION (Moderate)	2,409	1,750		72.6		27.4	
14	UNGULATES (Good)	6,271	3,322		53.0		47.0	
15	CONFLICT (Fair)	229	188					
16	AGRICULTURE (Fair)	1,730	145	333	8.4	19.2	91.6	80.8
17	FORESTRY (Fair)	9,549	6,921	7,109	72.5	74.4	27.5	25.6
18	RECREATION (Fair)	6,826	1,429		20.9		79.1	
19	CONFLICT (Poor)	310	282					
20	AGRICULTURE (Poor)	2,913	172	454	5.9	15.6	94.1	84.4
21	FORESTRY (Poor)	18,793	13,141	13,423	69.9	71.4	30.1	28.6
22	WATERFOWL (Good)	164	99		60.4		39.6	
23	UNGULATES (Good)	2,361	3		0.1		99.9	
24	NO USE	579	417		72.0		28.0	
25	FORESTRY	3,150	2,095		66.5		33.5	

*These columns, "Plus Conflict," indicate the maximum possible assignment to agriculture and forestry at each level, if lands in "conflict" for agriculture and forestry at the corresponding level were added to each of these uses in turn, exclusively.

For example, at Level 5, 9 quarter sections are identified as having equal potential for forestry and agriculture. At level 6, 39 quarter sections are assigned to agriculture. If all the quarter sections in 'conflict' at Level 5 were also assigned to agriculture, a total of 48 out of a possible 48 quarter sections which satisfy the criteria required to assign land to agriculture at this level, would be assigned. Thus, at present 81.3% of all quarter sections satisfying the required criteria are assigned at Level 6 but if all conflict areas were included 100% would be assigned.

Source: Alberta, Department of Municipal Affairs, Hinton-Yellowhead Regional Land Use Study, Allocation of Land According to Renewable Resource Potential, 1975.

As in the Lesser Slave Lake area there appeared to be little conflict between lands with excellent potential for each of the renewable resource uses.

Overall allocations by renewable resource uses for the Hinton-Yellowhead area are illustrated in the following table.

TABLE 84

RENEWABLE RESOURCE ALLOCATION
HINTON-YELLOWHEAD STUDY AREA

Resource Use	No. of Quarter Sections	Percent of Area
Agriculture	510	1.24
Forestry	31,698	77.15
Conflict (Ag/For)	579	1.41
Recreation	3,374	8.21
Ungulates	4,828	11.75
Waterfowl	99	.24
Total	41,088	100.00

It is interesting to compare the southern half of the allocation map prepared for the Peers-Whitecourt Land Use Study with the allocation map prepared for the Hinton-Yellowhead Land Use Study. The former which considered regional priorities allocated much of the southern half of the study area to agriculture. In the latter which was based on provincial priorities the same area was allocated to forestry. It is important to consider local priorities, but they should definitely be evaluated in respect to provincial priorities. Logically the Hinton-Yellowhead study should have been completed before the Peers-Whitecourt study.

The methodology of the Hinton-Yellowhead study is described in Allocation of Land According to Renewable Resource Potential - Hinton-Yellowhead Regional Land Use Study prepared by the Regional Planning Section of Alberta Municipal Affairs in 1975. The renewable resource information for the entire study area is illustrated through three maps at a scale of 1:250,000: Map 1 - Potential Forest Production, Map 2 - Potential Agricultural Production and Map 3 - Allocation of Land by Renewable Resource.

It must be remembered that the allocation process described for the Lesser Slave Lake Regional Plan and the Hinton-Yellowhead Regional Land Use Study represents only one component in the preparation of a regional plan. The allocation map must be combined with additional physical, economic and social data before a rural land using zoning concept can be developed.

6. The Foothills Resource Allocation Study

The development and preparation of the Foothills Resource Allocation Study by Alberta Lands and Forests paralleled the two planning studies prepared by Municipal Affairs. As previously indicated, the prime data base for all three studies was the Canada Land Inventory and the same computer system was utilized. However, there are some major differences between the studies conducted by Lands and Forests and Municipal Affairs.

The Foothills Resource Allocation Study was initiated in 1970 under an agreement between the Canada Land Inventory Pilot Land Use Planning Program and the Province of Alberta. Provincially the study was administered by the Forest Land Use Branch of the Alberta Forest Service. Alberta Environment provided additional funding for the study in 1972.

> The Foothills Resource Allocation Study is a comprehensive planning program designed to determine the most beneficial allocation of resources on the basis of productivity and economic considerations. Multiple use as a concept is projected into every aspect of the design and is intended for consideration in all areas defined on the resulting zoning scheme...One of the primary objectives of the Foothills Study is to evaluate the information compiled in the renewable resources capability studies of the Canada Land Inventory. The study also sets out to determine what type

> of physical and socio-economic data are required in preparing a comprehensive plan as well as to establish what useful planning information is available. Probably the most significant purpose is to provide the Government of Alberta with a design for the most beneficial allocation of resources in the Foothills region.[217]

The area covered by this study extends along the eastern slopes of the Rocky Mountains from Waterton Lakes National Park in the south to Grande Prairie in the north. The Hinton-Yellowhead area is not included. The 47,395 sq. km. (18,300 sq. mi.) contained within the study area were divided into 26 drainage districts for purposes of analysis. For each drainage district a detailed physical capability report was prepared. The study was divided into four specific phases. Phase I involved the physical capability analysis of each drainage district, phase 2 evaluated current demands on and supply of the physical resources of the foothills, phase 3 provided forecasts on the demands for the resources to 1985 and anticipated government revenues from these resources and phase 4 was to be a regional land use plan which would place supply and demand relationships into perspective.

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[217] Alberta, Lands and Forests, Forest Land Use Branch, The Foothills Resource Allocation Study, Phase I, Upper Brazeau Drainage District, 1973, p. 1.

(a) Physical Capability Analysis Component

The Canada Land Inventory has been utilized as the primary source of data in the first phase.

> In phase I three basic considerations are introduced. Within each Drainage District there is an initial assessment of the physical capability of the land to supply the various resources. Then the compatibility for each resource use is evaluated and summarized on a series of Resource Interaction Tables; through a sequence of analytical steps the complexities of these data are resolved and plotted on a resource capability map...The third consideration introduced into phase I is a documentation of existing land uses.[218]

In addition to the C.L.I. capability classifications, the following renewable and non-renewable resources were analyzed: archaeology, coal, forest cover, industrial minerals, key ungulate range, livestock grazing, metallic minerals, oil and gas and watershed.

Unlike the priority table prepared by Alberta Municipal Affairs, a listing sequence was developed for the Foothills Resource Allocation Study. The capability ratings along with supplementary resource data were rated on a scale of 0 to 9. It is indicated that this was done because the various resource inventories had been rated independently. Since the primary source of information was the Canada Land Inventory it would appear to have been more logical to use a scale of 1 to 7. The listing sequence used in the study is illustrated in table 85.

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[218] Ibid., p. 2.

This listing sequence is further complicated because grade 9 is better than grade 0 while in the C.L.I. class 1 is better than class 7.

Having developed the listing sequence the next step in the study involved the assignment of resource priorities at the quarter section level. Priority was given to the resource with the highest grade as indicated in the listing.

> When two resources in a quarter section have the same capability grade, the preferred resource is determined as follows. As the Drainage District as a whole will not be able to provide an equal abundance of both resources, the resource with the lower area weighted total (arrived at by the method described in table 86) in the whole District will be designated as the preferred resource within the quarter section. This system will tend to arbitrate in favour of resources which though present in high capability in a single quarter section, may be rare or thinly spread over the rest of the District.[219]

"The area weighted total is calculated for each resource by adding together the number of quarter-sections multiplied by their grades: thus four quarter sections of Grade 2 and three of Grade 5 would give an area weighted total of (4 x 2) + (3 x 5) = 8 + 15 = 33."[220]

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[219] _Ibid_., pp. 5 - 6.

[220] _Ibid_., p. 12.

TABLE 85

LISTING SEQUENCE AND WEIGHTING FACTORS

	Quality									
Resource	Nil	Low	Moderate		Good		Excellent			
Archaeology	4		3		2		1			
Agriculture Capability	7 & 0		6	5	4	3	2		1	
Coal	0	L		M			H			
Forest Capability	7	6		5		4	3			
Forest Cover	other	L		M		H				
Livestock Grazing	4	3		2			1			
Industrial Minerals	0	L		M			H			
Metallic Minerals	0	L		M			H			
Oil and Gas		L		M			H			
Recreation Capability	7 & 8	6		5	4	3	2		1	
Sport Fish Capability	4		3		2		1			
Ungulates Capability	7	6	5	4	3	3W	2	2W	1	1W
Waterfowl Capability	7	6	5	4	3	3M	2		1	
Watershed		3		2			1	Key		
Key Ungulates										
Grade	0	1	2	3	4	5	6	7	8	9

The letters and numbers in the body of the table are the capability ratings obtained from the resource inventories. The table converts these ratings to the ten point grade system on the bottom line.

Source: Alberta Lands and Forests - Foothills Resource Allocation Study, 1973.

TABLE 86

UPPER BRAZEAU DRAINAGE DISTRICT
GRADE TOTALS FOR RESOURCE INVENTORIES

Resource	Quality										Area Weighted Total
	Nil	Low	Moderate		Good		Excellent				
Ungulates	86	709	43	320	685	530	0	62	0	2	7597
Recreation	0	997	0	933	463	70	1	0	0	0	6004
Watershed	0	1228	0	1170	0	0	65	0	0	0	5128
Forest Cap.	1225	252	0	808	0	148	0	0	0	0	3416
Oil & Gas	0	2387	0	76	0	0	0	0	0	0	2615
Sport fish	1957	0	0	0	506	0	0	0	0	0	2024
Ind. Minerals	1742	721	0	0	0	0	0	0	0	0	721
Grazing	1860	544	0	30	0	0	0	0	0	0	664
Key Range	2353	0	0	0	0	0	0	72	0	14	630
Coal	2326	61	0	76	0	0 0	0	0	0	0	289
Forest Cover	1560	106	0	52	0	4	0	0	0	0	282
Waterfowl	2238	222	2	0	0	0	0	0	0	0	226
Agriculture	2437	0	0	0	0	0	0	0	0	0	0
Metallic Minerals	2463	0	0	0	0	0	0	0	0	0	0
Archaeology	0	0	0	0	0	0	0	0	0	0	0
	0	1	2	3	4	5	6	7	8	9	

Source: Alberta Lands & Forests, The Foothills Resource Allocation Study Phase I, Upper Brazeau Drainage District, 1973.

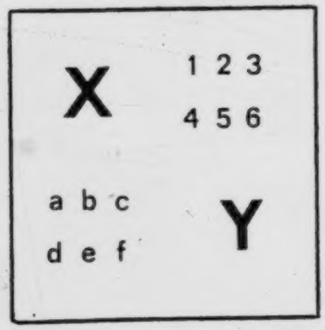
The allocation system, consisting of listing sequences and weighting factors, used in the Foothills Resource Allocation Study is significantly different from the Provincial Priority table used in the Hinton-Yellowhead and Lesser Slave Lake studies. In the former the preferred use between resource that have the same grade in a quarter is determined by its scarcity in the drainage district. Thus, consistency is not maintained in allocation throughout the various drainage districts. The Provincial Priority table allocates land on a consistent basis throughout the province as the table has been designed to eliminate conflicts except when forestry and agriculture yields are considered to be equal.

Another major difference between the Municipal Affairs system and that of Lands and Forests is the mapping program. The Allocation of Land by Renewable Resource maps of the Hinton-Yellowhead and Lesser Slave Lake studies were colour coded by resource use and by decreasing levels of intensity as the level of assignment decreased. (Recreation shades of red, Waterfowl - shades of blue, Ungulates - brown, Agriculture - yellow, Forestry - green and conflict - purple. Although there are twenty-five levels of assignment, overall patterns, on the 1:250,000 maps for the two studies can be easily identified, and quarter-section allocations can be determined upon closer inspection.

The data processing system employed in the Foothills Resource Allocation Study was identical to that developed by Municipal Affairs. The mapping output was considerably different. A computer activated CALCOMP plotter produced 1:126,720 maps which indicated the allocation decisions on a quarter-section basis. Separate maps were prepared for each drainage district and each quarter section contains several symbols, letters and numerals. The maps were printed in black and white and the complexity of information shown made them extremely difficult to interpret. It is also impossible to obtain an overview of the resource potential for major segments of the foothills because the maps were printed by drainage districts.

Each drainage district report contains a CALCOMP generated C.L.I. capability map and a resource capability map which includes both renewable and non-renewable data.

> On the computer maps each quarter section is represented by a block of four quadrants into which information can be plotted. Within two of these quadrants twelve minor positions provide for a display of specific details. The figure as a whole shows the capability, priority and effects of interaction for each resource considered in the quarter section.

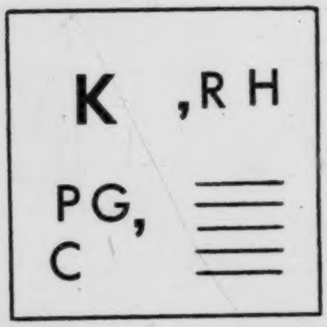


(all resources having capability rating of Grades 0 to 1 (low) are disregarded)

In position X is indicated the preferred resource in the unit, and in position Y is indicated its capability.

In positions 1, 2, 3, 4, 5 and 6 are indicated compatible resources of progressively lower preference.

In positions a, b, c, d, e and f are indicated conflicting resources of progressively lower preference. When a comma (,) is inserted in any of the positions a through e or 1 through 5, resources shown after the comma in that quadrant have moderate capability ratings while resources listed before it have good or excellent capability ratings.



For the quarter section shown in the accompanying example the preferred resource use is a key ungulate range (K), excellent capability. (three horizontal lines indicates good, one indicates moderate). Resources that are compatible with the key range are moderate capability recreation (R) and moderate capability watershed (H). Resources which may be in conflict with the ungulate range are oil and gas (P) and grazing (G), both having high capability, and also a moderate capability coal resource (C).[221]

Interpretation problems associated with this system are obvious. At a scale of 1:126,720 each quarter section occupies .41 sq. cm. (.0625 sq. in.) which is further subdivided into four quadrants. Concentrated effort is required to interpret the quarter section ratings and it is impossible to visualize any overall patterns from the maps.

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[221] *Ibid.*, p. 8.

In addition to the two resource capability maps each drainage district report contains a present land use and disposition map and a preferred resource map which have been prepared with the Calcomp plotter. This latter map is a simplified version of the two resource capability maps as only the preferred resources are shown for the quarter sections. Various symbols are used to show these preferred uses and their capability levels, and they also pose interpretive problems.

(b) Evaluation of System and Comparison with Provincial Priority Table

In May of 1972 the first drainage district report the Kananaskis - Spray Drainage District Phase One - Preliminary Analysis was released. This area was chosen to test the methodology of the Foothills Resource Allocation Study because it had already come under considerable pressure for development and was believed to contain most of the land use conditions that would be found in the Eastern Slopes.

The differences in the methodology between this study and the Hinton-Yellowhead Regional Land Use Study were obvious. The Conservation and Utilization Committee of the Alberta Government expressed concern about these differences for it was considered desirable to prepare consistent guidelines for land use allocation throughout the entire Eastern Slopes. To investigate these differences the Research Planning Section of Municipal Affairs on the request of the Conservation and Utilization Committee in August 1972 prepared Evaluation and Planning Alternatives Kananaskis - Spray Drainage District Phase I.

The following overall conclusions were determined from the analysis:

> The phase of land use planning carried out in Kananaskis - Spray Drainage District - Phase I should have been based on an Alberta perspective of land resources rather than limiting the scope to a subregional level. Allocation of land in the preliminary land use plan should be restricted to the renewable resource of agriculture, forestry, outdoor recreation, ungulate production and waterfowl production. Other present and potential resource uses should be considered at a later stage of planning...All lands including those having existing or potential mineral extraction sites, should be allocated to a renewable resource use in the first stage of the preliminary land use plan...The preliminary land use plan as we envisage it, should therefore be considered the framework within which the renewable resources assigned should be managed or in the confines of which more localized and specialized uses can be assigned. The strength of this phase of land use planning is the allocation of large areas of land to renewable resource uses based on uniform criteria.[222]

This description of renewable resource allocation prepared by the Research Planning Section of Municipal Affairs is, of course, biased in favour of the Municipal Affairs methodology as opposed to that of the Foothills Resource Allocation Study. However, it should be noted that the Provincial Priority Table of Municipal Affairs had not been fully developed when this evaluation was prepared.

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[222] Alberta, Municipal Affairs, Research Planning Section, Evaluation and Planning Alternatives, Kananaskis - Spray Drainage District Phase I, August 1972, pp. 1 and 2.

In evaluating the methodology of the Foothills Resource Allocation Study emphasis was placed on the scarcity factor. The Municipal Affairs planners strongly disagreed with the use of the scarcity factor at a sub-regional level and indicated that scarcity should be estimated at a provincial level.

> The Kananaskis - Spray Drainage District illustrates this argument very well. An examination of the data indicates relatively numerous areas of high quality potential recreation sites in that 15.57% of the sub-region or 293 of 1,882 quarter sections are classified as Recreation Capability Classes 2 and 3. Similar data for the Lesser Slave Lake Special Area Sub-regions 1, 3, 4 and 6 indicates 0.41% of the total area or 217 of 53,670 quarter sections have recreation potential of comparable quality. In addition the 1:250,000 maps for the areas adjacent to the Kananaskis - Spray Drainage District indicate that this small sub-region contains virtually all the high capability recreation sites in a large area which includes the City of Calgary. This clearly indicates the necessity for consideration of supply at a provincial scale regardless of ease of quantification.[223]

The Municipal Affairs evaluation also challenged the validity of the scarcity index.

> The scarcity index as used in the Kananaskis-Spray Drainage District is logically and mathematically incorrect. The index is the sum of a series of multiplications of capability grades and the number of quarter sections in each grade. The higher the

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[223] Ibid., p. 25.

> grade is, the more important the lands in that grade are. But for absolute scarcity, the importance of the class is increased by a small number. In effect then; the capability grade offsets the purpose of the scarcity index. If the index is to be accurately calculated, a reverse system of grades must be used.[224]

To indicate the differences between both systems the Provincial Priority Table was applied to the Kananaskis - Spray sub-region and the Scarcity Index and Weighting System of the Foothills Resource Allocation Study was applied to Area 1 of the Lesser Slave Lake study area. The use of the Priority table in the Kananáskis-Spray sub-region resulted in the allocation of 396 more quarter sections to recreation, 588 more quarter sections to no value and 1188 less quarter sections to ungulates.

The use of the Weighting System in Area 1 of the Lesser Slave Lake study area resulted in the allocation of 28 less excellent recreation sites from a total of 48 identified through the priority table, and 3429 less quarter sections to agriculture, 734 of which contained excellent agricultural potential. The number of quarter sections assigned to ungulates increased by 1544.

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[224] Ibid., p. 26.

The major difference between the two methodologies appears to be in the assignment of land to ungulates. The Provincial Priority Table recognizes the importance of ungulate wintering ranges while in addition the Foothills methodology stresses the importance of 1 and 2 wildlife habitat. Class 2 ungulate capability receives the same weighting as class 2 agriculture capability. In the majority of cases the Provincial Priority Table assigns ungulate habitat as a secondary land use with usually agriculture or forestry being the primary use.

In 1973 the Task Force on the East Slopes Hearings of the Alberta Conservation and Utilization Committee prepared a report for the Environment Conservation Authority entitled The Resources of the Foothills: A Choice of Land Use Alternatives. The report was intended to serve as a pre-hearing background document for the hearings that were to be held on land use in the Eastern Slopes.

The report prepared primarily by the staff of the Foothills Resource Allocation Study, summarizes the material from the Drainage District reports prepared for the Northern and Southern Foothills Regions. The potential of the resources is thus based on the allocation process developed for the Foothills Resource Allocation Study.

In July 1973, Dr. A. H. Laycock on behalf of the Alberta Geographical Society submitted a brief to the Environment Conservation Authority entitled Land and Water Resource Development in the Eastern Slopes. The brief commented on a variety of resource issues in the Eastern Slopes, but emphasis was placed on the evaluation of the report The Resources of the Foothills: A Choice of Land Use Alternatives:

> In the Foothills Resource Allocation Study summary tables in Appendix A of 'The Resources of the Foothills' paper, fifteen use categories have been rated. This selection was arbitrary because demand studies have not been made for watershed and other use categories. Four wildlife categories are included - Ungulates, Sport Fish, Waterfowl Capability and Key Range. In contrast Recreation Capability and Watershed Conditions are undivided. Recreation might well have a dozen or more distinct categories based upon different demand requirements...If equal value is given to top ratings in each identified category of use, the more use categories the better if the interests of any interested group are to be served. With four wildlife categories out of fifteen listed the end result will tend to be wildlife oriented relative to recreation or watershed with one category each.[225]

In the paper it is indicated that the importance of watershed to the Eastern Slopes has been minimized while ungulates and key ranges have been emphasized. This emphasis appears to be unfounded since the Eastern Rockies Conservation Board Acts had stressed the importance of watershed and the benefits accrued to the many downstream users.

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[225] Dr. A. H. Laycock, Land and Water Resource Development in the Eastern Slopes , a brief submitted to the Environment Conservation Authority by the Alberta Geographical Society, July 1973, pp. 3 - 4.

Dr. A. H. Laycock also challenges some of the high ratings assigned resources in the Foothills because of severe natural limitations.

> In practice equal ratings for the top categories of each use are very unrealistic. Harold Wilm has suggested that the respective values of grazing, forestry, watershed and recreation are \$2.00, \$20.00, \$200.00 and \$2,000.00 per acre per year for the Eastern Slopes in National Forests in Colorado. There is a high level of subjective judgement involved but vast differences have been recognized by many authorities. With this scale, recreation and watershed would be dominant in virtually all areas...For example, if we start with an assumption that recreational use in the Northern and Southern Foothills Region is worth only one percent of that suggested for Colorado, i.e., \$20.00 per acre per year, then using the weighted capability totals for excellent, good, moderate and low ratings for ungulates and key range, each ungulate would have to be worth \$4,250.00 per year of presence within these areas. A mature buck of 10 years of age would have been worth \$42,500.00 in the decade. If we compare excellent ratings for recreation and ungulates plus key range, each animal would have to be worth \$167,000.00 per year.[226]

The over-emphasis on ungulates, as indicated in the evaluation of the Kananaskis-Spray Drainage District by Alberta Municipal Affairs, has again been stressed in Dr. A. H. Laycock's brief. The supply of ungulates is also discussed in terms of a provincial perspective.

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[226] Ibid., pp. 5-6.

> In the Foothills Resource Allocation Study, great stress is put on management to meet the needs of ungulates. If the region were a productive supplier of ungulates or some species were in danger of extinction, and management for other purposes resulted in major reductions in numbers, this might be reasonable. Instead, this region has a relatively low productivity and management for other purposes can have, in some cases, positive effects upon numbers. As for survival of species, mule and white-tailed deer, now constituting over half of the ungulate numbers present in the region, are numerous in the plains to the east and northeast and elsewhere.[227]

Phase I of the Foothills Resource Allocation Study had demonstrated an unique approach in the use of the capability classifications of the Canada Land Inventory in the allocation of renewable resources. The two main areas of criticism have been the use of the scarcity index on a drainage district basis and the Calcomp generated maps which have been difficult to interpret. The methodology which was developed, however, has contributed significantly in the evolution of a land use planning philosophy for Alberta.

7. Land Use Assignment Studies

As indicated previously the Land Use Assignment Branch of Alberta Energy and Natural Resources had been engaged in the preparation of biophysical studies since the mid-nineteen sixties. Before evaluating the studies of the Land Use Assignment Branch, it is important to have an understanding of the biophysical process and classification and their development in Canada.

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[227] *Ibid.*, p. 11.

(a) Biophysical Methodology

The procedures followed in Alberta are based on the system developed in the Research Branch of the Ontario Department of Lands and Forests in the late nineteen fifties.

> The initial objective of this land use research was to designate and describe those areas of Ontario which are suitable for the expansion of agricultural communities. This objective has been broadened gradually over the years since 1944 to meet problems arising from the management of all the renewable natural resources under the jurisdiction of the Department.[228]

The land classification system developed by the Ontario Department of Lands and Forests and specifically by G. A. Hills is described in two detailed reports The Ecological Basis for Land Use Planning, Research Report No. 46 prepared by G. A. Hills of the Department of Lands and Forests in 1961 and Developing a Better Environment: Ecological Land Use Planning in Ontario prepared by G. A. Hills, D. V. Love and D. S. Lacate for the Economic Council of Ontario in 1970.

After the completion of most of the field work for the Canada Land Inventory capability classifications in the late nineteen sixties, a number of resource specialists across Canada, especially forestry personnel, felt that the capability classification did not provide an adequate base for the development of management plans for forest and wildlands. A sub-committee or Biophysical Land Classification was established under the Canada Land Inventory with the following objectives:

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[228] G. A. Hills, Research in Land Classification and Mapping for Multiple Resource Management, Annual Meeting of the Canadian Association of Geography , McMaster University, Hamilton, Ontario, 1962, p. 1.

> (1) To examine and review systems of land classification developed and used at national and regional levels. (2) To present recommendations to the National Committee on Forest Land concerning a suitable physical land classification, of a reconnaissance nature, that will provide a base from which lands can be classified as to their use for Forestry, Agriculture, Recreation, Wildlife and Water Yields.[229]

The biophysical studies of the Land Use Assignment Branch have evolved from the work done by G. A. Hills, and more recent studies reflect the guidelines prepared by the sub-committee on Biophysical Land Classification. These more recent studies also contain an evaluation phase.

> Land classification, in the specific sense, involves a process which identifies, describes and names areas in terms of their natural features without attempting to rate them (Biophysical Land Classification). In contrast, land evaluation consists of a series of ratings, for all types of uses, of the units established by the land classification (Biophysical analysis and evaluation of capability.).[230]

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[229] Canada, Department of Fisheries and Forestry, Canadian Forestry Services, Guidelines for Biophysical Land Classification, Ottawa, 1969, p. 1.

[230] Alberta, Lands and Forests, Technical Division, Land Use Assignment Section, Manual of Biophysical Land Classification and Evaluation of Capability, 1974, p. 35.

The purpose of the system is to differentiate and classify the ecological segments of the land surface and four distinct levels of classification are identified.

> Level I - Land Region. The Land Region is presently defined as an area of land characterized by a distinctive regional climate as expressed by vegetation. Land Region is usually of large areal extent and is inevitably more or less heterogeneous. It is often an aggregation of several distinctive contiguous landscapes. Examples of Land Region would be Tundra, Alpine, Montane, Boreal and Grassland.
>
> Level II - Land District. The Land District is defined as an area of land characterized by a distinctive pattern of relief, geology, geomorophology and associated sub-regional vegetation.
>
> The Land District is a subdivision of the land region based primarily on the separation of major physiographic and/or geologic patterns which characterizes the region as a whole.
>
> Level III - Land System - The Land System is presently defined as an area of land throughout which there is a recurring pattern of landforms, soils and vegetation. Land System is a subdivision of a land district based on any physiographic features of significance in land use. Variations of significance within the land district include soil profile, stoniness, slope, aspect as well as lesser variations in texture and petrography of of soil materials within the broad range which defines the land system.
>
> Level IV - Land Type - The Land Type is presently defined as an area of land, on a particular parent material, having a fairly homogeneous combination of soil at a level corresponding to the soil series and phases and chronosequence of vegetation.[231]

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[231] Ibid., pp. 36, 39, 42, 42, 44.

The Biophysical studies of the Land Use Assignment Branch focus on Level III the Land System and within each land district in a particular study area the various land systems are described in detail. A description of a typical land system in one of the Biophysical studies is as follows:

> Land System VI b(S)
>
> Physiography - This land system consists of the south facing erosion slopes of the major river valleys.
>
> Soil Association - Complex of eroded surfaces and colluvium.
>
> Present Use - Wildlife - domestic grazing.
>
> Natural Cover - Aspen Poplar and white spruce with a variety of shrubs and grasses on the eroded surfaces.
>
> Ratings
>
> Agriculture - 6T and 7T. At best this land system is suited to unimproved grazing. The grazing capacity and efficiency of cattle gain is questionable.
>
> Forestry - 6 and 7 UM
>
> Ungulates - 1 and 2W
>
> Waterfowl - 6TB
>
> Recreation - 45KQLROY.[232]

The major criticism of the Land Use Assignment Studies deals with the creation of these ratings. The source is the Capability Classifications of the Canada Land Inventory; however, the original boundaries have been adjusted to correspond to land systems. Within the biophysical studies they are referred to as use capability classes or use potential rates.

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[232] Alberta, Energy and Natural Resources, Technical Division, Land Use Assignment Section, Biophysical Analysis and Evaluation of Capability Clear River Area, 1976, pp. 30-31.

The boundaries of the C.L.I. capability classifications are obviously not coterminous; therefore, certain judgements must be made to convert them to land systems. A three position grouping system is used by the Land Use Assignment Branch to make these conversions, and it appears to be based on a system developed by G. A. Hills and described in The Ecological Basis for Land Use Planning published in 1961. The system is described as being

> readily usable and in providing a close approximation of ratings for most areas. The exceptions are those complex combinations of classes and proportions which do not lend themselves to averaging into three classes. The scheme thus provides for three levels of use capability at three levels of proportion of total area occupied by each class.
>
> Use - capability classes are used to indicate the levels of potential and the position which these occupy in a three-letter designation indicating the relative proportion occupied by each class.
>
> Indication of Proportion in 3-Letter Symbols

Position in Symbol	Actual Range	Mode Used for General Comparisons
First letter	79 - 35%	50%
Second letter	11 - 44%	30%
Third letter	10 - 32%	20%

The symbol in the first position on the left has been used to mean that an average of 50% of the area has the indicated level of capability, that in the second position an average of 30% of the area, and that in the third position an average of 20%. Where one or two levels occupy the entire scale, the same letter may occupy two or three positions as follows:

AAA means approximately 100% of A
AAB means an average 80% A and 20% B
ABA means an average 70% A and 30% B
ABB means an average 50%A and 50%B

Seven groups have been chosen which are approximately equivalent to areas which exclusively belong to each use - capability class as follows:

Community Pattern	Mode (Use - Capability Class)
First rate	A
Second rate	B
Third rate	C
Fourth rate	D
Fifth rate	E
Sixth rate	F
Seventh rate	G

The next step involved the assignment of weights to show differences in distribution patterns.

Class A - 29, B - 27, C - 24, D - 20, E - 15, F - 9 and G - 1.

For the purpose of determining equivalence of patterns, the modal 50-30-20 proportion was used. For example, the pattern ACG was calculated as follows:

A = 29 x 50 - 1450
C = 24 x 30 720
G = 1 x 20 20
2190

> The placing of the 343 three position classes into the seven point rating is indicated in table 87. This table was originally established for rating community patterns of agricultural use - capability classes. It has been found to serve equally as well for establishing the broad classification of forest and wildlife lands.[233]

The procedure described is the method by which use potential rates are established for the various land systems within each district identified for a particular study area. The nebulous nature of the procedure is obvious. The procedure, in addition, is questionable for it was established by G. A. Hills prior to the development of the Canada Land Inventory and therefore was not intended to use capability data. A great amount of detail is obviously lost in the conversion of the data to use potential rates because the boundaries of the five capability classes used are different from the land system boundaries.

(b) Evaluation of Land Use Assignment Studies

Research was conducted by the author to evaluate the differences between C.L.I. capability classification boundaries and use - potential rate boundaries in the *Biophysical Analysis and Evaluation of Capability Study for the Blueberry Mountain Area* of the Peace River Country. The boundaries of the units within the five classifications are all different and it would appear to be virtually impossible to merge these boundaries together to fit the land system units.

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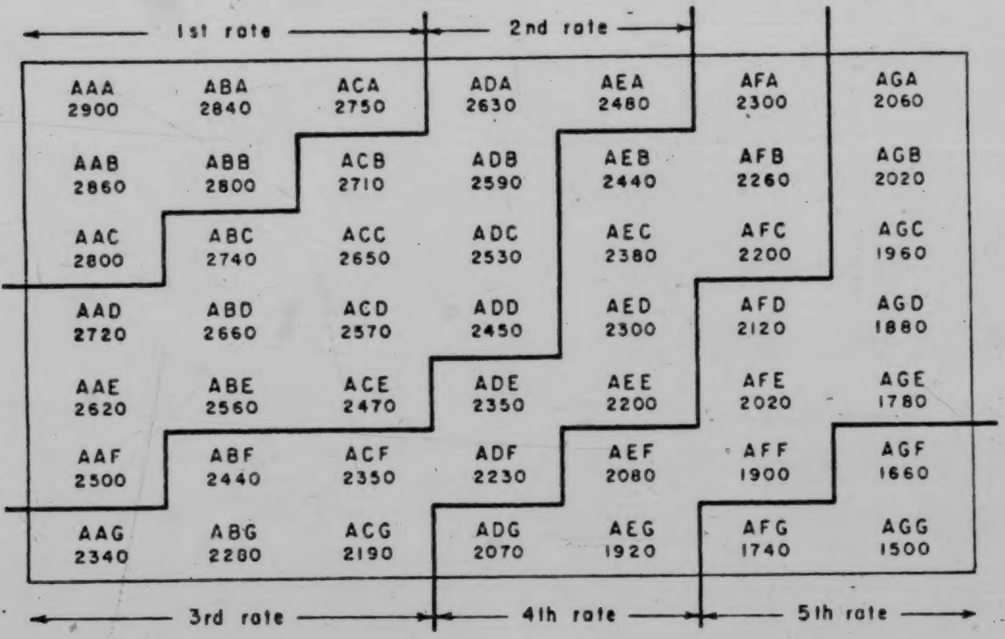
[233] Alberta, Lands and Forests, Technical Division, Land Use Assignment Section, *Manual of Biophysical Land Classification and Evaluation of Capability*, 1974, pp. 57-60.

Table 87

Establishment of Seven Use Capability Ratings From 343 Three-Position Classes

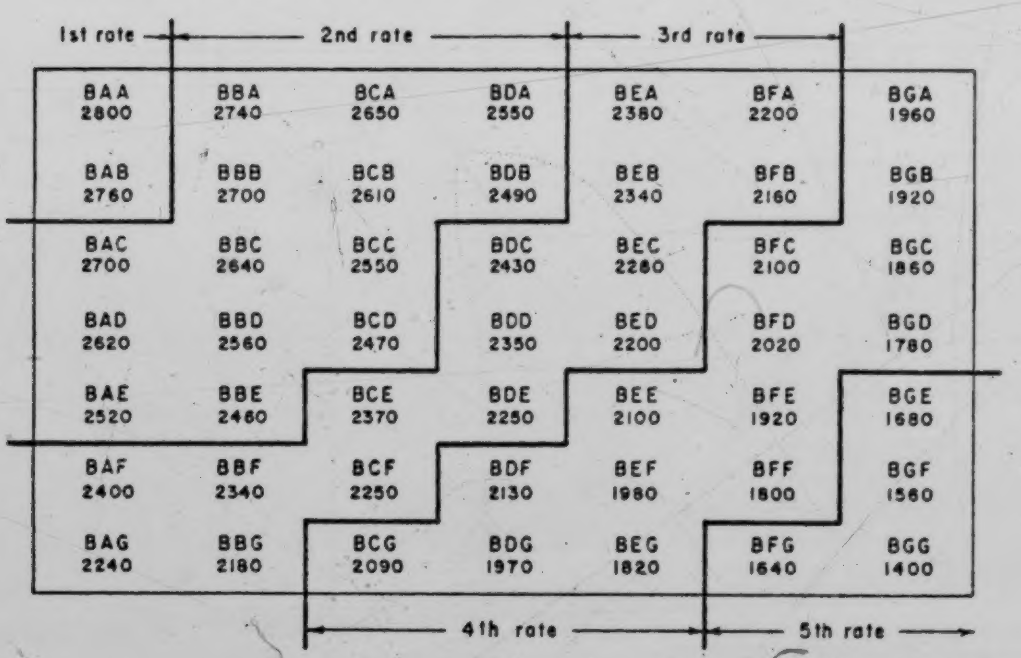
Landtype Patterns Dominantly Class A


1st rate
2nd rate
3rd rate
4th rate
5th rate

AAA 2900	ABA 2840	ACA 2750	ADA 2630	AEA 2480	AFA 2300	AGA 2060
AAB 2860	ABB 2800	ACB 2710	ADB 2590	AEB 2440	AFB 2260	AGB 2020
AAC 2800	ABC 2740	ACC 2650	ADC 2530	AEC 2380	AFC 2200	AGC 1960
AAD 2720	ABD 2660	ACD 2570	ADD 2450	AED 2300	AFD 2120	AGD 1880
AAE 2620	ABE 2560	ACE 2470	ADE 2350	AEE 2200	AFE 2020	AGE 1780
AAF 2500	ABF 2440	ACF 2350	ADF 2230	AEF 2080	AFF 1900	AGF 1660
AAG 2340	ABG 2280	ACG 2190	ADG 2070	AEG 1920	AFG 1740	AGG 1500

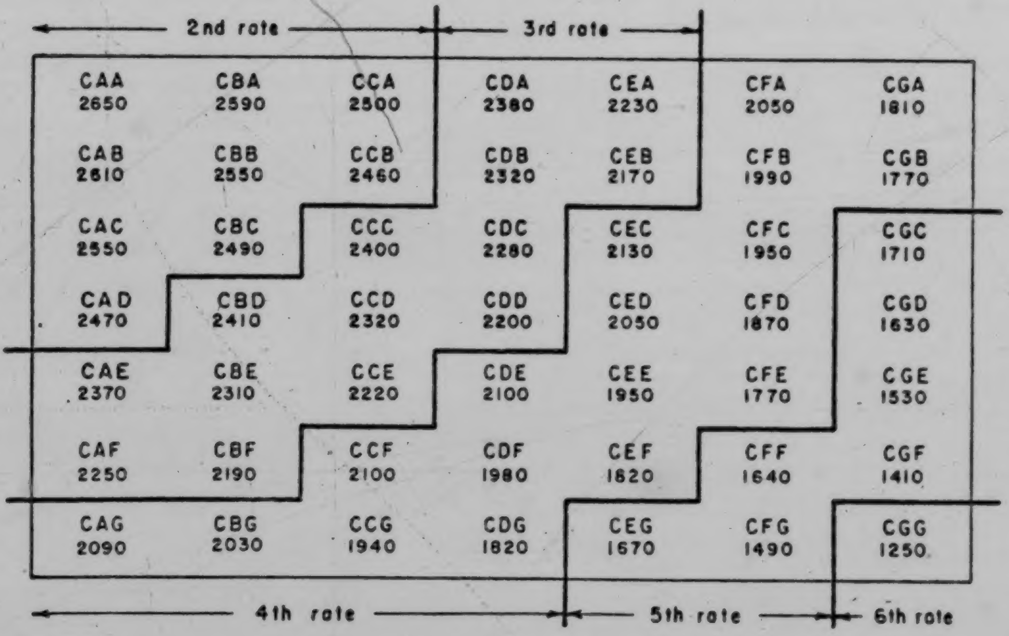
TABLE 87...continued

Landtype Patterns Dominantly Class B


1st rate
2nd rate
3rd rate
4th rate
5th rate

BAA 2800	BBA 2740	BCA 2650	BDA 2550	BEA 2380	BFA 2200	BGA 1960
BAB 2760	BBB 2700	BCB 2610	BDB 2490	BEB 2340	BFB 2160	BGB 1920
BAC 2700	BBC 2640	BCC 2550	BDC 2430	BEC 2280	BFC 2100	BGC 1860
BAD 2620	BBD 2560	BCD 2470	BDD 2350	BED 2200	BFD 2020	BGD 1780
BAE 2520	BBE 2460	BCE 2370	BDE 2250	BEE 2100	BFE 1920	BGE 1680
BAF 2400	BBF 2340	BCF 2250	BDF 2130	BEF 1980	BFF 1800	BGF 1560
BAG 2240	BBG 2180	BCG 2090	BDG 1970	BEG 1820	BFG 1640	BGG 1400

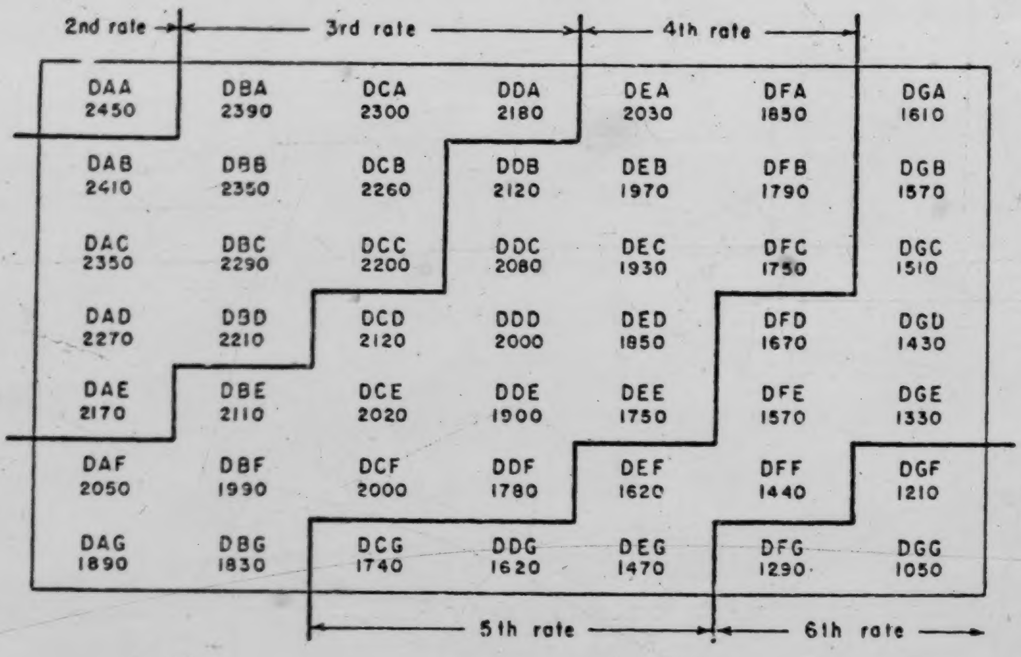
Landtype Patterns Dominantly Class C


2nd rate
3rd rate
4th rate
5th rate
6th rate

CAA 2650	CBA 2590	CCA 2500	CDA 2380	CEA 2230	CFA 2050	CGA 1810
CAB 2610	CBB 2550	CCB 2460	CDB 2320	CEB 2170	CFB 1990	CGB 1770
CAC 2550	CBC 2490	CCC 2400	CDC 2280	CEC 2130	CFC 1950	CGC 1710
CAD 2470	CBD 2410	CCD 2320	CDD 2200	CED 2050	CFD 1870	CGD 1630
CAE 2370	CBE 2310	CCE 2220	CDE 2100	CEE 1950	CFE 1770	CGE 1530
CAF 2250	CBF 2190	CCF 2100	CDF 1980	CEF 1820	CFF 1640	CGF 1410
CAG 2090	CBG 2030	CCG 1940	CDG 1820	CEG 1670	CFG 1490	CGG 1250

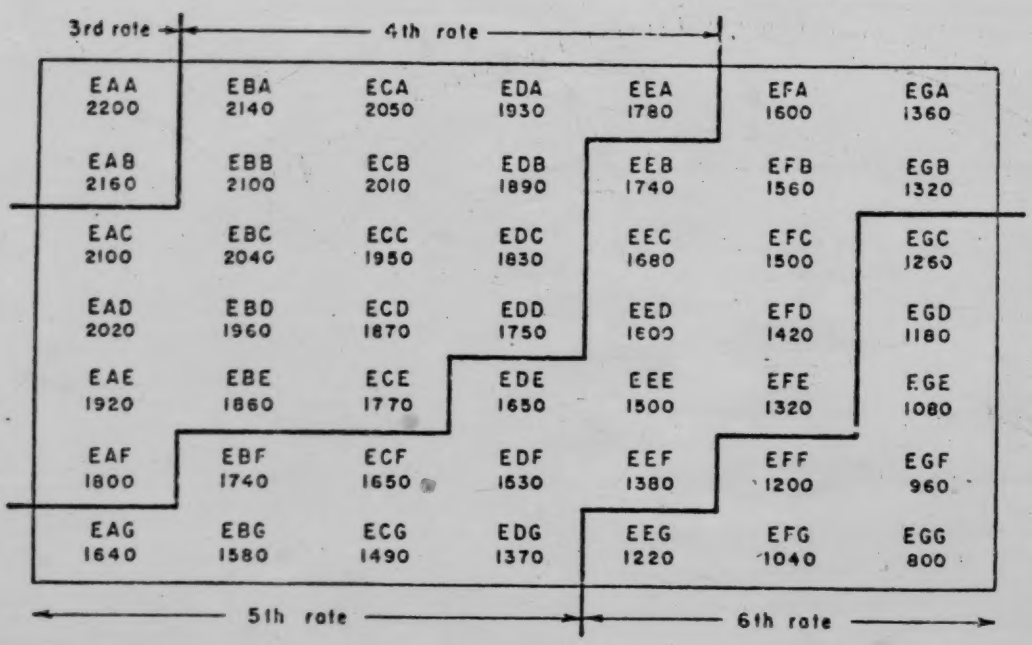
TABLE 87...continued

Landtype Patterns Dominantly Class D



DAA 2450	DBA 2390	DCA 2300	DDA 2180	DEA 2030	DFA 1850	DGA 1610
DAB 2410	DBB 2350	DCB 2260	DDB 2120	DEB 1970	DFB 1790	DGB 1570
DAC 2350	DBC 2290	DCC 2200	DDC 2080	DEC 1930	DFC 1750	DGC 1510
DAD 2270	DBD 2210	DCD 2120	DDD 2000	DED 1850	DFD 1670	DGD 1430
DAE 2170	DBE 2110	DCE 2020	DDE 1900	DEE 1750	DFE 1570	DGE 1330
DAF 2050	DBF 1990	DCF 2000	DDF 1780	DEF 1620	DFF 1440	DGF 1210
DAG 1890	DBG 1830	DCG 1740	DDG 1620	DEG 1470	DFG 1290	DGG 1050

Landtype Patterns Dominantly Class E



EAA 2200	EBA 2140	ECA 2050	EDA 1930	EEA 1780	EFA 1600	EGA 1360
EAB 2160	EBB 2100	ECB 2010	EDB 1890	EEB 1740	EFB 1560	EGB 1320
EAC 2100	EBC 2040	ECC 1950	EDC 1830	EEC 1680	EFC 1500	EGC 1260
EAD 2020	EBD 1960	ECD 1870	EDD 1750	EED 1600	EFD 1420	EGD 1180
EAE 1920	EBE 1860	ECE 1770	EDE 1650	EEE 1500	EFE 1320	EGE 1080
EAF 1800	EBF 1740	ECF 1650	EDF 1530	EEF 1380	EFF 1200	EGF 960
EAG 1640	EBG 1580	ECG 1490	EDG 1370	EEG 1220	EFG 1040	EGG 800

TABLE 87...continued

Landtype Patterns Dominantly Class F

4th rate — 5th rate

FAA 1900	FBA 1840	FCA 1750	FDA 1630	FEA 1480	FFA 1300	FGA 1060
FAB 1860	FBB 1800	FCB 1710	FDB 1590	FEB 1440	FFB 1260	FGB 1070
FAC 1800	FBC 1740	FCC 1650	FDC 1530	FEC 1380	FFC 1200	FGC 960
FAD 1720	FBD 1660	FCD 1570	FDD 1450	FED 1300	FFD 1120	FGD 880
FAE 1620	FBE 1560	FCE 1470	FDE 1350	FEE 1200	FFE 1020	FGE 780
FAF 1500	FBF 1440	FCF 1350	FDF 1230	FEF 1080	FFF 900	FGF 660
FAG 1340	FBG 1280	FCG 1190	FDG 1070	FEG 920	FFG 740	FGG 500

6th rate — 7th rate

Landtype Patterns Dominantly Class G

5th rate

GAA 1500	GBA 1440	GCA 1350	GDA 1230	GEA 1080	GFA 900	GGA 660
GAB 1460	GBB 1400	GCB 1310	GDB 1190	GEB 1040	GFB 860	GGB 620
GAC 1400	GBC 1340	GCC 1250	GDC 1130	GEC 980	GFC 900	GGC 560
GAD 1320	GBD 1260	GCD 1170	GDD 1050	GED 900	GFD 720	GGD 480
GAE 1220	GBE 1160	GCE 1070	GDE 950	GEE 800	GFE 620	GGE 380
GAF 1100	GBF 1040	GCF 950	GDF 830	GEF 680	GFF 500	GGF 260
GAG 940	GBG 880	GCG 790	GDG 670	GEG 520	GFG 340	GGG 100

6th rate — 7th rate

Source: Ontario Department of Lands & Forests, The Ecological Basis for Land Use Planning, 1961.

Overlays of the Land District map were placed over the original C.L.I. maps and differences between the C.L.I. ratings and the use potential rates were recorded. The changes were colour coded according to whether the change from C.L.I. to use potential went up or down and by how many classes. The capability classification which experienced the largest total change was agriculture, followed in order by recreation, forestry, ungulates and waterfowl. The capability with the greatest change of classes upward (going from C.L.I. to use - potential on the Land District map, e.g., C.L.I. 4 to use potential 3) was recreation, followed by ungulates, forestry, waterfowl and agriculture. For changes of classes downward (C.L.I. 3 to use potential 4) agriculture had the greatest change, followed by forestry, recreation, waterfowl and ungulates. Specific results of the analysis are summarized in table 88.

TABLE 88

BLUEBERRY MOUNTAIN STUDY AREA C.L.I.
USE-POTENTIAL CONVERSION*

(total study area 310,052 hectares (766,156 acres)

Forestry Capability

C.L.I. Rating	Use-Potential Rate	Conversion Hectares	(Acres)
4	3	5,201	(12,851)
5	4	9,987	(24,678)
7	5	13,468	(33,280)
4	5	24,851	(59,699)

Total forestry conversion upwards (C.L.I. to Use-Potential) 35,472 hectares (87,653 acres) 11.4% of total area.

Total forestry conversion downwards 32,780 hectares (81,000 acres) 10.6% of total area.

Total forestry conversion 68,292 hectares (168,653 acres) 22%.

Agriculture Capability

C.L.I. Rating	Use-Potential Rate	Conversion Hectares	(Acres)
5	4	5,998	(14,797)
7	3	6,118	(15,118)
0	3	1,036	(2,560)
2	3	56,183	(138,830)
3	5	21,900	(54,118)

Total agriculture conversion upwards 23,358 hectares (57,720 acres) 7.5% of total area.

Total agriculture conversion downwards 108,244 hectares (267,477 acres) 35%.

Total agriculture conversion 131,602 hectares (325,197 acres) 42.5%.

TABLE 88...continued

Ungulate Capability

C.L.I. Rating	Use-Potential Rate	Conversion Hectares	(Acres)
2W	1	4,741	(11,716)
3W	2	13,244	(33,727)
4	3	11,458	(28,314)
1W	2	4,914	(12,142)

Total ungulate conversion upwards 46,953 hectares (116,023 acres) 15.1%.

Total ungulate conversion downwards 10,922 hectares (26,990 acres) 3.5%.

Total ungulate conversion 57,875 hectares (143,013 acres) 18.6%.

Recreation Capability

C.L.I. Rating	Use-Potential Rate	Conversion Hectares	(Acres)
5	4	39,927	(98,662)
6	5	46,454	(114,790)
5	6	21,404	(52,890)

Total recreation conversion upwards 90,587 hectares (223,846 acres) 29.2%.

Total recreation conversion downwards 21,404 hectares (52,890 acres) 6.9%.

Total recreation conversion 111,991 hectares (276,736 acres) 36.1%.

TABLE 88...continued

Waterfowl Capability

C.L.I. Rating	Use-Potential Rate	Conversion Hectares	(Acres)
5	4	6,382	(15,770)
7	6	16,832	(41,593)
3	4	1,885	(4,659)
5	6	6,609	(16,333)
6	7	6,556	(16,201)

Total waterfowl conversion upwards 30,921 hectares (76,409 acres) 10%.

Total waterfowl conversion downwards 16,522 hectares (40,828 acres) 5.3%.

Total waterfowl conversion 47,443 hectares (117,237 acres) 15.3%.

*all individual conversions are not recorded.

Combining the five classifications it was found that 227,292 hectares (561,651 acres) were shifted upwards (C.L.I. to Use-Potential) and 189,872 hectares (469,185 acres) were shifted downwards.

It is interesting to note that agriculture was the only C.L.I. classification to have more of its area decreased in rating than increased. C.L.I. ratings were decreased for 108,244 hectares (267,477 acres). In forestry 28,490 hectares (70,400 acres) changed by 1 class, 20,492 (50,636) by 2 classes, 1,326 (3,276) by 3 classes and 145 hectares (358 acres) by 4 classes. In agriculture, 96,182 hectares (237,671 acres) changed by 1 class, 22,253 (54,988) by 2 classes, 2,017 (4,985) by 3 classes, 8,514 (21,038) by 4 classes and 2,632 (6,505) by 5 classes. In ungulates, 46,953 hectares (116,023 acres) changed by 1 class, 12,250 (30,271) by 2 classes and 207 (512) by 3 classes. In recreation 108,510 hectares (268,134 acres) changed by 1 class and 3,481 hectares (8,602 acres) by 2 classes. In waterfowl 41,912 hectares (103,568 acres) changed by 1 class, 4,289 hectares (10,598 acres) by 2 classes and 1,243 hectares (3,072 acres) by 3 classes.

The changes in ratings indicated in this analysis are considerable and one would certainly have to question the procedures of the Land Use Assignment Branch in this regard. The use - potential rates on the land district maps can certainly not be construed as being C.L.I. capability ratings and the C.L.I. should not have been used in establishing them. The Land Use Assignment Branch has extended the C.L.I. capability classes well beyond their potential.

Municipal Affairs wasn't the only department to question the Land Use Assignment Methodology as indicated in the following comments from the Lands Division of Alberta Lands and Forests. "Users of the land district maps as developed by the Land Use Assignment Section should be aware that the conversion of the original C.L.I. ratings to a single figure may be rather misleading."[234]

Both the Lands Division and the Alberta Department of Agriculture have challenged the Land Use Assignment Branch on the reduction of soil capability ratings in the Peace River Country. In the Clear River and Blueberry Mountain study areas many soil capability ratings were reduced by one class.

> From an agricultural viewpoint the analysis of the Clear River area is very disturbing. In the first place, it fails to indicate in either the land system description or the land district map, any Class 2 agricultural land while Canada Land Inventory inventories from which this analysis is supposedly prepared indicate a considerable amount in the area.
>
> Secondly the analysis reflects a distinct subjective bias against agricultural land use. For example, in discussing class 4 TD land the following comment is made, 'due to climatic conditions, this land system is considered to be unsuitable for cultivated agriculture

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[234] Alberta, Lands and Forests, Lands Division, C. W. Harke, Sturgeon Lake Study Review, 1973.

> production.' Why then did the soil surveyors rate it 4? If the Branch feels that Canada Land Inventory ratings are too high then they should clearly state why they think so and document their actions in downgrading the ratings. That has not been done. This surely reduces the confidence committee members may place in the biophysical analysis.[235]

In December of 1972 the Land Use Assignment Section completed the Biophysical Analysis and Evaluation of Capability: Kananaskis Spray Drainage District. This study was requested by the Conservation and Utilization Committee in order to provide an alternative to the Drainage District report prepared for the area through the Foothills Resource Allocation Study.

> The purpose of the request for a biophysical study was to obtain some quick measure by which to determine the usefulness of the Foothills Study for management purposes. Approximately 10% of the agriculture ratings were revised, 35% of the forestry ratings, 40% of recreation ratings, and 2% of waterfowl ratings. Twenty percent of the ungulate ratings in the alpine region were revised, 40% in the sub-alpine mountain slope region and 90% in the sub-alpine valley region.[236]

As indicated radical changes have been made to the original C.L.I. capability ratings, although no documented justification has been given for these changes. The Conservation and Utilization Committee requested clarification regarding the rationale for these changes and received the following response:

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[235] Alberta, Department of Agriculture, W. S. Pattison, Agriculture Input, Clear River Study Area, August 1973.

[236] Alberta, Lands and Forests, Land Use Assignment Committee, Kananaskis - Spray Drainage District Land Use Plan, Recommendations to the Deputy Minister, June 1973, p. 2.

> The Land Use Assignment Branch uses the C.L.I. data as a starting point and on the basis of detailed field investigations of biophysical factors modifies the ratings of the C.L.I. where appropriate. The need for this revision stems from the very broad nature of the C.L.I. and the inconsistencies in the inventory work.[237]

Regarding a comparison of the Land Use Assignment and Foothills methodologies in the study area it was suggested by the Land Use Assignment Branch that such a comparison was not possible because of substantial differences in the allocation process.

> A comparison of the two requires the application of conditions and assumptions so numerous and involved as to render the conclusion meaningless. The Committee suggests that the Foothills Study and the biophysical study are different phases of land use planning and that they have to be substantially different in various ways.[238]

In an attempt to further justify their changing of the C.L.I. ratings the Land Use Assignment Branch has indicated that

> the Canada Land Inventory was produced at great cost in time and funds for the purpose of land use planning. Efficient publicity during and after its production has generated unwarranted

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[237] Alberta, Environment, Conservation and Utilization Committee, Minutes of 122 Meeting, September 11, 1973.

[238] Alberta, Lands & Forests, Land Use Assignment Committee, Kananaskis - Spray Drainage District Land Use Plan, Recommendations to the Deputy Minister, June 1973, pp. 2 - 3.

> expectations for its use and as a result considerable pressure is exerted to make the Inventory serve all our land use planning purposes. In reality, the basic data used for the C.L.I. were at best incomplete and inadequate for anything more than a broad inventory. It should be understood that its application in land use planning is limited to a level that is consistent with the accuracy of the basic data. An optimistic estimate of the average minimum area for which a C.L.I. rating of any resource can be relied upon is probably not smaller than four square miles and much greater confidence can be placed on a considerably larger land unit.[239]

It is obvious from these comments that the Land Use Assignment Branch has little faith in the Canada Land Inventory; yet it has used this same inventory to establish its use - potential rates. There are many unanswered questions regarding this process. The biophysical component of the Land Use Assignment studies is indeed valid and provides much useful information. It is the evaluation of capability phase that presents the problem.

8. Growth in the Allocation Methodology of Alberta Municipal Affairs

Since the completion of the rural land use portions of the *Lesser Slave Lake Regional Plan* and the *Hinton-Yellowhead Regional Land Use Study*, a number of regional land use studies, which are based on the developed methodology, have been prepared. More important, the Land Use Planning Data Bank of Alberta Municipal

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[239] *Ibid*., p. 3.

Affairs has been expanded to cover all those portions of Alberta covered by the Canada Land Inventory capability classifications. The Provincial Priority Table can, therefore, be applied over most of the Province. In addition the Regional Planning Commissions now have a computerized resource inventory upon which to base their regional plans.

The Land Use Planning Data Bank, and the C.L.I. capability classifications within it, have been used by the Regional Planning Section of Alberta Municipal Affairs and several other agencies in regional land use analyses.

Prior to the development of the Luscar-Sterco coal mine at Coal Valley, Thurber Consultants utilized the Land Use Planning Data Bank and Provincial Priority Table to obtain a preliminary indication of renewable resource conflicts that could be anticipated with the proposed strip mine. The analysis indicated that the conflict would be with class 4 recreational capability land and with class 3 ungulate wintering range. This would be valid for the immediate mining area, but no mention is made of the effects of roads, noise, water and air pollution on surrounding areas and the capabilities of these areas.

(a) Allocation Procedures Developed by the Peace River and Red Deer Regional Planning Commissions

In 1972 the Peace River Regional Planning Commission prepared a report entitled Sturgeon Lake Sub-regional Land Use Study Area 1:

Valleyview Corridor. This study was based primarily upon the methodology developed for the Peers-Whitecourt Land Use Study, although the coding procedures used in the conversion of C.L.I. data were the same as those used in the Lesser Slave Lake Regional Plan.

Land was allocated on a quarter section basis according to the criteria indicated in the following table.

TABLE 89

OPTIMUM LAND USE DETERMINANTS-VALLEYVIEW CORRIDOR

1. Outdoor Recreation	
(a) Recreation Capability	3, 4
2. Wilderness Recreation	
(a) Ungulate Capability	1, 2, 3
3. Agriculture 1	
(a) Soils (soil survey of the Grande Prairie and Sturgeon Lake sheets)	soil series symbols RY, ES, DO, NP, KT, VV, CO, BB (equivalent to soil capability for agriculture classes 1 to 3)
4. Forestry 1	
(a) Forestry Capability	4
5. Forestry 2	
(a) Forestry Capability	5, 6, 7

Source: Peace River Regional Planning Commission, Sturgeon Lake Subregional Land Use Study Area 1: Valleyview Corridor, 1972.

The Valleyview Corridor study represents one of the first attempts by an outside agency to utilize the allocation methodology developed by Alberta Municipal Affairs. The study was to be the first in a series which would eventually cover the entire planning commission; however, subsequent studies were never prepared. It is believed that the land allocations recommended in the study were not realistic in terms of existing land use and disposition.

In 1972-73 the Red Deer Regional Planning Commission prepared a report entitled Physical Environment Inventory of the Red Deer Regional Planning Commission Area. A resource capability sieve map was prepared as part of the study, and this was based upon the Provincial Priority Table although the analysis was done manually. Since the process was conducted manually, the resource priorities are shown according to natural boundaries instead of by quarter section units.

> The priority order of resource capabilities is a slightly amended version of the priority table utilized by the Provincial Planning Branch in their computer program for land use assignments in various sub-regional studies. The priority order was chosen in consideration of resource scarcity and resource importance as related to social and economic considerations. The Resource Capability map has one principal value. On a single map it allocates for every area of land

> within the region its highest or best resource capability. In a sense, therefore, it could be construed as a regional land use plan based on primary resource capability. However, it is not a plan, although it is essential to plan preparation. Rather what the map does is provide a general insight, utilizing primary resource capabilities, into a regional land use pattern based on the highest order of resource use.[240]

The Priority Table developed by the Red Deer Regional Planning Commission is indicated in the following table.

TABLE 90

PRIORITY LIST OF RESOURCE CAPABILITIES

Order	Resource Capability	Order	Resource Capability
1	Recreation 1-2	9	Agriculture 4
2	Agriculture 1-2	10	Forestry 4
3	Waterfowl 1S-3M	11	Recreation 4
4	Ungulates 1W	12	Waterfowl 1
5	Recreation 3	13	Forestry 5
6	Agriculture 3	14	Agriculture 5
7	Forestry 3	15	Ungulates 1-2-3
8	Ungulates 2W	16	Other

Source: Provincial Planning Branch, Red Deer Regional Planning Commission, cited in *Physical Environment Inventory of the Red Deer Regional Planning Commission Area*, 1972-73.

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[240] Red Deer Regional Planning Commission, *Physical Environment Inventory of the Red Deer Regional Planning Commission Area*, 1972-73, p. 75.

Since the priority map shows only primary capability the Red Deer Regional Planning Commission developed a Land Use compatibility Matrix to indicate compatible and incompatible renewable and non-renewable land uses. The matrix is based on that developed by Ian L. McHarg and described in Design with Nature published in 1969. The results of the Resource Capability map and the Land Use Capability Matrix were then combined to prepare a listing of Potential Land Uses and Associations. Alternate land uses are shown for each of the resource priority zones and are listed as being preferred, secondary allowable, special circumstances only or incompatible. (see table 91).

(b) Recent Utilization of Provincial Priority Table and Allocation Procedures by Alberta Municipal Affairs

In November of 1975 several minor changes were made to the Provincial Priority Table. Level 25 assigned to forestry indicates those quarters which have a potential production of 1 to 1999 cubic feet of timber per year. This was the last level of assignment in both the Lesser Slave Lake and Hinton-Yellowhead study areas. However, in some of the southern areas of the province where there is no forest cover or where the forestry capability classification was not conducted it would be unrealistic to assign these quarters to forestry.

TABLE 91
POTENTIAL LAND USE AND ASSOCIATIONS

ALTERNATE LAND USES			URBAN	COUNTRY RESIDENTIAL	INSTITUTIONAL (NON-URBAN)	TRANSPORTATION	INDUSTRIAL (NON-URBAN)	QUARRYING		MINING			AGRICULTURE			FORESTRY		RECREATION						WATER MANAGEMENT	
RESOURCE PRIORITY ZONES								SAND, GRAVEL	CLAY	STRIP ACTIVE	STRIP RECLAIMED	SHAFT	CROP	MIXED	PASTURE	SAWTIMBER	PULPWOOD	WILDERNESS	VIEWING	LAKE, SHORE	PRAIRIE, PARKLAND	FOOTHILL, MOUNTAIN	RIVER VALLEY	WATERSHED	RESERVOIR
RECREATION	1-2	UPLAND	ALWAYS INCOMPATIBLE, BUT REQUIRED THROUGH PRECEDENCE	I	X	S	I	I	I	I	X	X			I	S	S	DECLARED BY SPECIAL LEGISLATION	P	P		P	P	A PRIMARY POLICY OF UPLAND AREAS	ONLY UNDER SPECIAL CIRCUMSTANCES
RECREATION	1-2	LOWLAND		I	X	S	I	I	I	I	X	X	X	X	S				P	P					
AGRICULTURE	1-2			I	X	S	I	I	I	I	X	S	P	P	S				S	S	S				
WATERFOWL	1S-3M			I	X	I	I	I	I	I	I	I	S	S	S				P	P	P				
UNGULATE	1W	UPLAND		I	X	S	I	I	I	I	I	S			X	S	S		P	P			P		
UNGULATE	1W	LOWLAND		I	X	S	I	I	I	I	I	S	I	I	S				P	P	P		P		
RECREATION	3	UPLAND		I	X	S	I	I	I	I	X	X			I	S	S		P	P		P	P		
RECREATION	3	LOWLAND		I	X	S	I	I	I	I	X	X	X	X	S				P	P	P		P		
AGRICULTURE	3			I	X	S	I	I	I	I	X	S	P	P	S				S	S	S				
FORESTRY	3			I	X	S	X	I	I	I	X	X			S	P	S		S	S		S	S		
UNGULATE	2W	UPLAND		S	X	S	I	I	I	I	I	S			X	S	S		P	P		P	P		
UNGULATE	2W	LOWLAND		S	X	S	I	I	I	I	I	S	I	I	S				P	P	P		P		
AGRICULTURE	4			S	S	S	S	S	S	I	X	S	P	P	P				S	S	S		S		
FORESTRY	4			S	S	S	S	S	S	I	X	S			X	P	S		S	S		S	S		
RECREATION	4	UPLAND		S	S	S	X	I	I	I	X	X			X	S	S		P	P		P	P		
RECREATION	4	LOWLAND		S	S	S	X	I	I	I	X	X	I	S	S				P	P	P		P		
WATERFOWL	1			S	S	S	I	I	I	I	I	I	S	S	S				P	P	P				
FORESTRY	5			S	S	S	S	S	S	I	X	S			S	P	S		S	S		S	S		
AGRICULTURE	5	UPLAND		S	S	S	S	S	S	I	X	S			P	P	S		S	S		S	S		
AGRICULTURE	5	LOWLAND		S	S	S	S	S	S	I	X	S	S	P	P				S	S	S		S		
UNGULATE	1,2,3	UPLAND		S	S	S	X	X	X	I	X	S			X	S	S		P	P		P	P		
UNGULATE	1,2,3	LOWLAND		S	S	S	X	X	X	I	X	S	I	I	S				P	P	P		P		

NOTE: This matrix is only a planning guideline and is subject to changes prior to the adoption of a regional plan.

SOURCE
Red Deer Regional Planning Commission

P - PREFERRED
S - SECONDARY ALLOWABLE
X - SPECIAL CIRCUMSTANCES ONLY
I - INCOMPATIBLE

Within the revised priority table established in 1975 twenty-seven levels of allocation were identified. Level 25 became a conflict category between forestry and agriculture with the production potentials being 1 to 1999 cubic feet of timber per annum and 1 to 1439 bushels of wheat per annum. The 26th level was assigned to forestry (1 to 1999 cubic feet of timber per year) and would be utilized where there was no agriculture capability information available. Level 27 was assigned to agriculture in those areas where there was no forestry data.

In 1976 the Regional Planning Section of Alberta Municipal Affairs conducted an investigation of possible new townsite locations in the Coalbranch. The Land Use Planning Data Bank and its mapping Program were utilized to indicate quarter sections that should be restricted from development due to their high capability for renewable resource use. Restricted areas were based on the following C.L.I. ratings.

Recreation - C.L.I. class 1, 2, 3, 4
Ungulates - C.L.I. class 1W, 2W
Forestry - C.L.I. class 3
Waterfowl - C.L.I. class 1S, 2S, 3S or 3M
Agriculture - C.L.I. class 1, 2, 3, 4

In March of 1975 the Government of Alberta established a Coal Development Steering Committee to prepare an overall, integrated perspective on coal development in Alberta. A Land Use Management Task Force was established and its terms of reference included an assessment of renewable resource potentials and priorities as they affected coal development and the identification of compatible and incompatible land uses. The Land Use Planning Data Bank and the Provincial Priority Table were utilized in the analysis of the renewable resource base.

In conjunction with a reclaimability assessment of the Grande Cache area a renewable resource potential overlay was prepared to indicate trade off values (value of renewable resource temporarily or permanently lost) with mining. These trade off values could be used as a basis for comparison between coal lease and reserve areas. The trade off values determined through the priority table are indicated in table 92.

As a supplement to the task force report the Regional Planning Section of Alberta Municipal Affairs prepared a report entitled The Optimum Renewable Resource Potential of Alberta Coal Fields and Isolated Coal Deposits. The report describes the potential for renewable resource production that would be lost if Alberta's coal fields and deposits were strip-mined. Overall results were obtained for the ninety-three identified coal fields and deposits in Alberta as indicated in table 93.

TABLE 92

RENEWABLE RESOURCE ASSIGNMENT PRIORITIES - GRANDE CACHE AREA

Priority Table Level of Assignment*	Optimum Renewable Resource Potential	Quarter Section in Lease Area	% of Lease Area	Relative Value
1	Recreation	1	0.1	Excellent
3	Ungulates	228	20.4	Excellent
13	Recreation	59	5.3	Moderate
14	Ungulates	329	29.5	Good
18	Recreation	26	2.3	Fair
21	Forestry	324	31.7	Poor
25	Forestry	120	10.7	No Value

*see table 79 for explanation

Source: Alberta Government, Land Use Management Aspects of Coal Development, Report of Task Force III to Coal Development Steering Committee, 1976.

TABLE 93

CUMULATIVE TABLE OF COAL FIELDS AND ISOLATED COAL DEPOSITS FOR ALBERTA

Priority Table Level of Assignment	Optimum Renewable Resource Potential	Sq. Mi.	Percentage
1	Recreation	10.5	.22
2	Waterfowl	49.5	1.02
3	Ungulates	465.75	9.62
4	Agriculture	428.5	8.85
5	Agric./For.	.25	.01
6	Agriculture	214.5	4.43
7	Forestry	60.75	1.25
8	Recreation	47.5	.98
9/10	Agric./For.	33.5	.69
11	Agriculture	844.75	17.44
12	Forestry	568	11.73
13	Recreation	150.75	3.11
14	Ungulates	89.75	1.85
15	Agric./For.	24.5	.51
16	Agriculture	560.25	11.57
17	Forestry	174.	3.59
18	Recreation	132.25	2.73
19	Agric./For.	46	.95
20	Agriculture	330	6.81
21	Forestry	286.75	5.92
22	Waterfowl	19.75	.41
23	Ungulates	48	.99
24	Organic	14.5	.30
25	No Use	243	5.02
	Total	4843	100.00

Source: Alberta Municipal Affairs, The Optimum Renewable Resource Potential of Alberta Coal Fields and Isolated Coal Deposits Appendix 4, 1976.

According to the priority table, 6,159 sq. km. (2,378 sq. mi.) of identified coal fields and deposits (47.1%) were allocated to agriculture in the province. Approximately 27% of these 6,159 sq. km. (2,378 sq. mi.) were class 1 and 2. In total 2,823 sq. km. (1,090 sq. mi.) 22% were allocated to forestry. 1,562 sq. km. (603 sq. mi) 12% were allocated to ungulates and 77% of these were class 1 and 2 winter ranges. 883 sq. km. (341 sq. mi.) 7% were allocated to recreation, however, only 26 sq. km. (10 sq. mi.) of this total were class 1 and 2. 179 sq. km. (69 sq. mi.) 1.4% were allocated to waterfowl, but 129 sq. km. (50 sq. mi) of this total were class 1, 2 or 3 staging areas or 3 migration stops. In the report, The Optimum Renewable Resource Potential of Alberta Coal Field and Isolated Coal Deposits, this information is divided according to the Northern, Central and Southern Plains, the Foothills and the Mountains. Although the information is not sufficiently detailed for management planning it does give an indication of the relative importance of those areas covered by coal fields and isolated coal deposits for the production of renewable resources.

In 1977 the results of this analysis of coal fields and deposits was presented to the Coal Industry Reclaimation Symposium of the Coal Association of Canada by the Alberta Forest Service.

During 1976 and 1977 the Regional Planning Section of Alberta Municipal Affairs prepared several Country Residential Studies, and the Land Use Planning Data Bank was utilized in the identification of sites suited for this purpose. The Slave Lake Country Residential Study was undertaken in 1976 to identify areas within the vicinity of the Town of Slave Lake which would provide an alternative to urban residential development. One of the objectives of the study was "to preserve the environmental quality of the area by restricting country residential development from areas with high C.L.I. capability ratings."[241]

The following areas would be restricted from development:

C.L.I. Recreation Capability 1, 2 and 3
Forestry Capability 3*
Agriculture Capability 2, 3, 4**
Ungulate Capability 1 and 2 wintering ranges
Waterfowl Capability 1 and 2 staging areas

*There is no forestry capability 1 and 2 in the study area.

**There is no agriculture capability 1 in the study area.

In 1977 a similar country residential study was conducted by the Regional Planning Section in the County of Athabasca. The number of applications for country residential sub-divisions had increased from 11 in 1974 to 55 in 1976, and the number of parcels in each sub-division had also increased substantially. An increasing demand for non-lakeshore recreational parcels was also being experienced. The County of Athabasca, therefore, requested that a planning strategy be prepared to determine the best locations for these types of development.

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[241] Alberta, Municipal Affairs, Slave Lake Area Country Residential Study, 1976, p. 1.

The Canada Land Inventory was utilized in determining locations where country residential development would be prohibitive and it was recommended that the County zoning bylaw be amended to include the following:

> Sub-division for country residential purposes shall be prohibited on:
>
> (a) (i) lands having a Canada Land Inventory rating for agriculture of class 1, 2 or 3,
>
> (ii) lands which are currently in agricultural use and assessed as arable land or improved pasture,
>
> (b) lands having a Canada Land Inventory rating for recreation of class 1, 2 or 3,
>
> lands rated class 4 with sub-class K (camping) or H (historical significance),
>
> (c) lands having a Canada Land Inventory rating for forestry of class 3,
>
> (d) lands having a Canada Land Inventory rating for waterfowl of class 1S, 2S, 3S or 3M,
>
> (e) lands having a Canada Land Inventory rating for wildlife (ungulates) of class 1W, or 2W,
>
> (f) lands exhibiting evidence of poor drainge, flooding or lands with steep (greater than 15%) slopes,

(g) lands which lie within the Tawatinaw Valley, as designated by the Prime Protection Zone Map in the County of Athabasca Country Residential Study - Part One.[242]

Neither the Slave Lake nor County of Athabasca country residential studies were legislated through zoning bylaws. A decrease in resource and economic activity in the Slave Lake area negated the demand for country residences. All the sites indicated for development in the study were on Crown land and there was opposition to releasing lands for non-resource purposes.

In the County of Athabasca local politics prevented the implementation of the recommendations. The study does, however, provide a guideline for the Planning Services Division in the handling of sub-division applications in the County.

(c) Expansion of the Allocation Methodology in the Lesser Slave Lake Study Area

The rural land use component of the Lesser Slave Lake Regional Plan contained an Allocation of Land by Renewable Resource map based on the Provincial Priority Table. Each quarter section within the study was allocated as having potential for a specific renewable resource use. The information, however, was not sufficiently comprehensive to establish a rural land use bylaw without considering a variety of social, economic and physical factors.

In 1976 the Regional Planning Section of Alberta Municipal Affairs commenced the preparation of a report entitled Additional Factors and Their Effect on the Allocation of Land by Renewable Resources. The study examined the following factors: accessibility, disposition and present land use, watershed protection, non-renewable resource exploitation, compatible - incompatible renewable resource land uses and relative provincial location. These factors were then evaluated in terms of the Allocation of Land by Renewable Resource map and the following adjustments were made:

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[242] Alberta Municipal Affairs, Planning Services Division, Regional Planning Section, County of Athabasca Country Residential Study Part One 1977, p. 57.

Accessibility - isolated quarter sections in the northern portions of the study area which had been allocated to agriculture were changed to forestry. Isolated quarter sections allocated to agriculture in the southwest which had good access and were near areas already being used for agriculture remained in that use.

Surface disposition and Present land use - These factors were considered where quarter sections had equal potential for both agriculture and forestry. If a conflict quarter was surrounded by Crown land under forest cover it was assigned to forestry. If a crown quarter of forested land was surrounded by patented farmland it was allocated to agriculture. The status of surrounding land was thus a key factor in the allocation of conflict quarter sections.

Watershed protection - Where possible land adjacent to watercourses or waterbodies was zoned for ungulates, waterfowl or recreation.

Non-renewable resource exploitation - Quarter sections which contained producing oil or gas wells were zoned for a compatible land use such as agriculture or forestry.

Compatible - Incompatible land uses - The compatibility of various land uses were investigated to establish the secondary land uses for each prime use zone.

Relative Provincial location - The location of the Lesser Slave Lake region in regard to the rest of the province was important in determining the demand on the region for renewable resources. The supply of resources within the region was also evaluated relative to provincial supply.

Having evaluated these components in light of the original 25 allocation levels, a rural land use zoning concept was developed which contained two types of zones, exclusive use and prime use.

> Exclusive use zones are those land use zones which have a high capability for a particular land use which is usually not compatible with other land uses. A small number of conditional uses are possible only under rigid, carefully controlled circumstances. These areas are usually relatively small in areal extent and scarce provincially. Prime use zones on the Land Use Classification Guide are areas of land

> which are best suited for the indicated use. These zones can accommodate limited secondary uses without suffering any detrimental effects to the prime use. Forestry zones can support both extensive recreation and ungulate summer range areas with little reduction in the benefits derived from forestry.[243]

The zones established for the Lesser Slave Lake region are shown in table 94.

The rural land use zones were combined to form nine zones which were used in the development of a Zoning Control Direction for the Lesser Slave Lake Regional Plan area.

Exclusive Use Zones

1. Excellent Recreation
2. Excellent Waterfowl
3. Excellent Ungulate Range
4. Excellent and Good Agriculture

Prime Use Zones

1. Good Recreation
2. Good Waterfowl
3. Good Ungulate Range
4. Good and Fair Forestry
5. Fair Agriculture

Conservation Zone - all remaining lands.

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[243] Alberta Municipal Affairs, Planning Division, Regional Planning Section, Lesser Slave Lake Regional Plan, Section V, Rural Land Use Zoning Map 1976, p. 27 (unpublished).

TABLE 94

RURAL LAND USE ZONES - LESSER SLAVE LAKE REGION

Exclusive Use Zones	C.L.I. Class	
Excellent Recreation	1, 2, 3, 4	intensive and site specific
Excellent Waterfowl	1S, 2S, 3S, 3M	staging areas and migration stops
Excellent Ungulates	1W, 2W	wintering range
Excellent Agriculture	2	arable
Good Agriculture	3, 4	arable or pasture
Prime Use Zones		
Good Recreation	4, 5	4 extensive, 5 intensive
Good Waterfowl	1, 2	production areas
Good Ungulates	1, 2, 3W	summer range
Good Forestry	3, 4	commercial timber
Fair Agriculture	5, 6	pasture
Fair Forestry	5, 6	
Fair Recreation	5, 6	extensive
Fair Waterfowl	3, 4, 5	
Fair Ungulates	3, 4,5	
Good Sportfish	2	
Conservation Zone	all land not previously allocated	

Source: Lesser Slave Lake Regional Plan, Section V, Rural Land Use Zoning Map, 1976.

The Zoning Control Direction contained descriptions of each zone as well as permitted and conditional uses. An example of a prime use zone is as follows:

> Good Recreation - Purpose: To preserve the natural beauty of woodland, upland and lakeshore areas (CLI class 4 extensive and 5 intensive) for the recreational enjoyment of the public through maintaining significant topography, flora, fauna, ground and surface water and other natural resource characteristics.
>
> Permitted Uses: Extensive recreational activities such as hiking, canoeing, cross-country skiing and snowshoeing,ungulate and wildlife refuge, forestry operations, oil and gas exploration and extraction.
>
> Conditional Uses: Cottage developments.[244]

In addition to the zones indicated, symbols were placed on the zoning map to indicate class 2 sportfish zones, oil and gas fields and coal lease areas.

The Land Use Classification Guide and Zoning Control Direction are intended to act as advisory documents for those who are responsible for land use decisions in the Lesser Slave Lake region. They are not intended to be used at the quarter section level or to be used as rigid forms of control. The Land Use Classification Guide and Zoning Control Direction were never implemented through legislation. Due to changed priorities within the Planning Division of Municipal Affairs the preliminary documents were not finalized; however, they are used in the evaluation of sub-division applications.

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[244] Ibid., p. 44.

(d) Cold Lake Oil Sands Sub-regional Study

In 1977 Imperial Oil Limited announced their intention to develop a heavy oil sands upgrading plant in the Cold Lake area. For several years Imperial Oil and several other companies had been operating experimental insitu oil extraction plants in the Cold Lake area and the Planning Division of Municipal Affairs had been undertaking preliminary planning studies in anticipation of increased oil sands development. With Imperial Oil's announcement the Regional Planning Section of Alberta Municipal Affairs accelerated their involvement in the area and prepared the Cold Lake Oil Sands Sub-regional Study to serve as a preliminary regional plan. A major component of the study involved an evaluation of the renewable resource potential of the region.

The Cold Lake sub-region contains some of the best lakes and lake-shorelands in the Province. In addition there are major tracts of good agricultural land and significant ungulate winter ranges. Oil Sands development would place increased direct and indirect pressure on these renewable resources. The actual oil leases surround some of the best lakes in the region, and increased population as a result of oil sands development would place development pressure on the lakes for cottages and on the agricultural lands for country residences.

In addition to local pressures the lakes of the region are becoming a major destination for Edmontonians. In fact 57% of the cottage owners on Marie Lake and 42% on Moose Lake are from Edmonton.

In assessing the renewable resource potential of the Cold Lake sub-region the Land Use Planning Data Bank and the Provincial Priority Table of Alberta Municipal Affairs were utilized. An allocation map was developed similar to those prepared for the Hinton-Yellowhead and Lesser Slave Lake studies but contained only 14 levels of assignment as compared to 25 in the two previous studies. These 14 levels were reduced to 10 in the development of the Preliminary Land Use Guide.

As in the development of the Land Use Classification guide for the Lesser Slave Lake Regional Plan a number of factors such as regional location, access and present land use were assessed. In the settled portion of the Cold Lake Study sub-region

> all conflict quarter sections and quarter sections allocated to forestry are designated to agriculture if the present use is agriculture or if they do not form part of a significant block of forested land. In the Green Area, all conflict quarter sections and quarter sections allocated to agriculture are designated for forestry unless they have some form of agricultural disposition. Some quarter sections which were initially designated for agriculture are changed to forestry due to their inaccessible location.[245]

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[245] Alberta, Municipal Affairs, Planning Division, Regional Planning Section, Cold Lake Oil Sands Sub-regional Study, January, 1978, pp. 87-88.

The following Preliminary Land Use Guide was developed:

TABLE 95

PRELIMINARY LAND USE GUIDE
COLD LAKE OIL SANDS SUB-REGION

Land Use Zones	C.L.I. Class
Recreation I	1, 2, 3B
Wildlife I	1W, 2W
Waterfowl I	1, 2
Agriculture I	3, 4
Forestry I	3, 4
Recreation II	4 site-specific
Wildlife II	1, 2, 3W
Agriculture II	5
Forestry II	5
Marginal Use	6, 7 and all other lands not previously assigned

Source: Alberta Municipal Affairs, Cold Lake Oil Sands Sub-regional Study, 1978.

In addition to the Preliminary Land Use Guide the study recommended that the rural municipalities adopt a number of interim controls.

> Country residential development not be permitted in class 1 land use zones. Resort or lakeshore development be in accordance with an existing lake management plan or, where no lake management plan is prepared not be permitted in class 1 zones. Development in all class 2 zones should be considered a conditional use subject to the provisions of the Planning Act and the Subdivisions Regulation.[246]

(These classes do not refer to C.L.I. classes but to the class I and II land use zones).

Both the Foothills Resource Allocation Study and the Hinton-Yellowhead Regional Land Use Study provided valuable background information for the development of the Eastern Slopes Resource Management Policy prepared by the Eastern Slopes Interdepartmental Planning Committee in 1977. Although not specifically referenced in the report the eight land use zones - prime protection, critical wildlife, special use, general recreation, multiple use, agriculture, industrial and facility were largely based on the Canada Land Inventory capability classifications and their allocations through the Foothills and Hinton-Yellowhead studies.

The future of the methodologies developed by the Alberta Forest Service and Alberta Municipal Affairs are questionable. With the completion of the Foothills Resource Allocation Study, the study team was disbanded. The Phase I reports of the study have received minimal use due to their difficulty of interpretation. The expertise that was developed has been channelled in to other areas of concern, and it is unlikely that the renewable resource allocation procedure will be used in the future.

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[246] Ibid., p. 99.

As has been indicated the allocation methodology developed for the Hinton-Yellowhead and Lesser Slave Lake studies has been expanded and refined and utilized in a variety of studies. However, its future is also uncertain. In 1974 the Land Use Planning Data bank was removed from the Planning Division and centralized with other computer facilities within the Department of Municipal Affairs. The close liaison between the systems analysts and the regional planners was no longer possible. Gradually the use of the Land Use Planning Data Bank and the Provincial Priority Table has decreased and it is now virtually non-existent. All the computer staff and regional planners involved in the development of the system have left Municipal Affairs and, because it was not properly documented, procedures cannot be passed on to new staff. The expertise that was developed is lost, and it is unlikely that the renewable resource allocation procedures will be used in future regional studies.

The most significant utilization of the Canada Land Inventory in renewable resource allocation studies in Alberta was attained in the period between 1970 and 1975. In the Peers-Whitecourt Land

Use Study, Foothills Resource Allocation Study, Hinton-Yellowhead Regional Land Use Study and the Lesser Slave Lake Regional Plan techniques for the utilization of the Canada Land Inventory in regional planning, superior to anywhere else in Canada, were developed. In these studies the renewable resource base for regional planning in Alberta was formulated. However, regional planning has never been a priority of governments and senior management not understanding the systems nor recognizing the importance of long range planning allowed its gradual disintegration. Instead of moving forward the renewable resource component of regional planning in Alberta has moved backwards in recent years.

CHAPTER X

SUMMARY AND CONCLUSION

1. Summary

In this thesis the author has outlined the development of the Canada Land Inventory and documented some of the many uses that have been made of its various components.

As has been indicated, one of the earliest renewable resource inventories in Canada was probably conducted by Captain John Palliser in 1857-58 when his expedition evaluated the settlement potential of the western prairies. The conservation movement gained momentum during the latter half of the 19th century as a result of the misuse of renewable resources, especially soils for agriculture, and in 1909 the Commission of Conservation was established.

Concerns over the misuse of soils and a desire to settle people on the most productive soils in Western Canada resulted in the initiation of soil surveys in the 1920's and 30's, and in 1935 the Prairie Farm Rehabilitation Act was passed to help farmers in the development of these prairie lands. Conservation concerns in Eastern Canada resulted in the passage of the Conservation Authorities Act in Ontario in 1946 and the Maritime Marshlands Rehabilitation Act in Nova Scotia and New Brunswick in 1948.

The recommendations of the Senate's Special Committee on Land Use in Canada in 1957 and the Resources for Tomorrow Conference in 1961 were extremely influential in leading to the creation of the C.L.I. Both called for the establishment of renewable resource inventories across the country.

These concerns on conservation culminated in the passage of the Agricultural Rehabilitation and Development Act in 1961 and the birth of the C.L.I. The first A.R.D.A. agreement ran from 1961 to 1965 and during this period of time the Canada Land Inventory was initiated. The focus of the Inventory would be on the establishment of six classifications: present land use, agriculture, forestry, recreation, ungulates and waterfowl. Soil surveys had been conducted for agriculture, but little research had been conducted regarding the classification of land for the other renewable resource uses. Inventory research was hastily initiated, but by 1965 the actual field work was just beginning. Administrative problems also led to delays as the A.R.D.A. organizational structure involved the ten Provinces and the Federal Government.

A second A.R.D.A. agreement was signed for 1965-1970 and it was during this time that most of the classifications were conducted. Although Provincial co-ordinators were located in various regions across the country, consistency was difficult to maintain as progress varied considerably in the classifications. The classifications were to be consistent across Canada; however, it was virtually impossible to control provincial bias. By 1968 approximately $15,000,000 had been expended on the Canada Land Inventory, the majority of which came from the Federal Government. This, however, is only a pittance compared to the overall A.R.D.A. budget of $266,000,000 for this period.

Now that the classifications were basically complete concern was expressed as to how the information could be used. Previous research had concentrated on the structures of the classifications but very little had been done on their utilization. As no guidelines for use existed people began to use the classifications in any manner that they felt appropriate.

Before evaluating the uses made of the classifications it is important to understand their structures and the assumptions made in each. The reconnaissance and general nature of the classifications must be understood. They were not intended to be used in detailed site planning. It must also be remembered that the capability classifications were developed to portray capability and potential and not present land use. The level of detail in each of the classifications was different and the accuracy of each varied from region to region. In some regions the agricultural capability classification was based on detailed soil surveys while in others it was based on the interpretation of small scale air photos.

Having evaluated the structures of the classifications, the next step is the analysis involved in the establishment of the reliability of each of the classifications. The present land use classification was primarily based on air photo interpretation, and its accuracy was dependent upon the year, time of year and scale of the photography and upon the technical ability of the interpreters.

Considerable controversy has centred on the reliability of the agricultural capability classification. Some have argued that there is little difference between the soil productivity of the various classes. It has also been said that the class boundaries are not sufficiently precise for land use designation. Still others have indicated that the class ratings are either too high or too low. However, research in Ontario by D. W. Hoffman and J. S. Anderson indicates fairly high correlations between capability classes and productivity. Studies of rural real estate values in Alberta also confirm this relationship.

The productivity figures associated with the forestry capability classification support its accuracy. It is, however, argued that the classification of lands is not consistent and some areas are rated higher or lower than they should be.

Criticism of the recreation capability classification has centred on its subjectivity. Shorelands which were classified in the field appear to be accurate while those classified from air photos are less accurate and are suspect. The classification of upland areas appears to be less reliable.

A major concern in the ungulate classification was that the first series of maps to be produced was based on soil capability for ungulate fodder and browse while subsequent maps were based on the concept of best natural habitat. Many of the earlier maps were changed but the accuracy of the ratings are still a matter of concern. The classification in remote areas was based solely upon air photo interpretation. The classification of the wintering ranges appears to be fairly accurate, but some ratings assigned to habitat areas could be questioned.

Little information on the reliability of the waterfowl capability classification could be obtained. All of the classification work across Canada was conducted under the direction of one agency, the Canadian Wildlife Service, and the designation of the migration stops appears to be reliable.

The reliability of the sport-fish capability classification is unknown as it has not been possible to verify the physical and chemical criteria upon which the classification was based.

Despite some limitations, the completion of the various classifications has been a major step in obtaining a better picture of our renewable resource base. When it is recognized how little information we had before and how many expansive claims had been and were being made, the making available of information of this nature was a remarkable step forward.

Through the facilities of Alberta Municipal Affairs' Land Use Planning Data Bank a number of comparisons were made between classifications. Results of the tests indicated that 35% of the quarter sections in the study area had identical class ratings for forestry and agriculture. Results also indicate that there is a correlation between present land use and capability.

A number of variables contained in farmland assessment records, soil survey reports and grain elevator permits have also been discussed, but research was not conducted.

With an understanding of the structure and reliability of the classifications it was now possible to evaluate some of the uses made of the information. The present land use classification has been used in establishing the setting for land use studies and providing a base upon which the capability classification can be analyzed.

Numerous uses have been made of the soil capability classification for agriculture. One of its primary uses has been to document the loss of high capability lands from agricultural production. Since the completion of the Canada Land Inventory most regional land use studies contain a section on agriculture in which the potential is illustrated through the soil capability classification. Statistics on the percentage of land covered by each soil class are usually provided, and recommendations are made as to those classes of land which should be reserved for agriculture.

The public awareness of the agriculture classification is adequately indicated in the public hearings of the Alberta Land Use Forum. Of the 209 briefs presented, 40 of them made reference to this classification. Several of the Alberta Regional Planning Commissions have incorporated the agriculture classification into their land use policy documents and preliminary regional plans. At the local level several Alberta municipal districts and counties have prepared zoning bylaws in which the designated agricultural lands are based on soil classes.

In most of the studies conducted across the country which have used the agriculture classification, recommendations have been that classes 1 to 3 or 1 to 4 lands should be reserved for the production of crops.

Few examples exist on the use of the forestry capability classification as most forest lands are Crown owned, and forestry personnel require more detailed information than that provided in this classification. As with the agriculture classification it has been used in land use studies to indicate long range forestry potential.

The recreation classification has been utilized extensively to identify shoreland units which offer potential for both public and private recreational development. In Alberta, the classification has been used to indicate the critical absence of high capability shorelands and to stress the importance of the few that do exist. Attempts have also been made to apply the classification in the development of standards for cottage sub-divisions. In terms of legislation the recreation classes have been incorporated into the Alberta Land Conservation and Reclamation Act in order to restrict specific activities along shorelands.

The prime use of the ungulate classification has been in the identification of winter ranges, and some of the Regional Planning Commissions have used the information in their Preliminary Regional Plans. Similarly the waterfowl classification has been used to identify migration stops. This classification has also been incorporated into the guidelines of the Alberta Land Surface Conservation and Reclamation Act.

Use of the capability classification of fresh water for sport fish has been minimal. It has been used in a few land use studies to indicate lakes and rivers with sport-fish potential.

Some of the more important uses of the capability classifications have been shown in those studies in which comparisons have been made between the classifications and land use priorities established. The Red Deer Regional Planning Commission developed a scenic lake classification in which three levels of use or attractiveness were identified - provincial, regional and local. Each level was based on a combination of waterfowl, ungulate, sport-fish and recreation ratings.

In British Columbia land capability analysis maps were prepared for several regions, and these maps through a system of priorities, based on capability classification classes, indicate the highest and best land use for particular areas. Similar studies were also prepared in Quebec.

Several land use studies that were completed in the Maritimes contained integrated capability maps based on a number of classification classes. Land use priorities were developed from these class ratings, and in most cases the top priority was for agriculture. Generally, overlay procedures (sieve mapping) were used in producing these resource allocation maps.

Sieve mapping techniques were also used in developing the land capability analysis component of Ontario's regional development plans and in several land use studies in Alberta. These techniques would gradually disappear as methods of computer processing become more prevalent.

Under the original terms of reference of the Canada Land Inventory a geographic information system was to be developed. Through this computer system it would be possible to make comparisons between capability classes and do away with manual sieve mapping techniques. Many problems were encountered in the development of the system and it was not until 1975 that the system became operational and available to users in the provinces. By this time many users had already developed their own computer systems for analyzing the C.L.I. data which had been available for several years.

In Ontario a computer system in which the capability class data were collected and analyzed on four square kilometre units was developed. Research into the creation of a computer system was also undertaken in Manitoba. In this Data Cell system the quarter section was chosen as the unit of input. A number of other computer systems were also developed to handle the C.L.I. data, but these along with systems developed in Ontario and Manitoba never became prevalent.

During the past decade a considerable amount of research has been conducted in Alberta on the use of the classifications of the Canada Land Inventory in regional planning. In 1969 the Alberta Department of Municipal Affairs completed the Peers-Whitecourt Land Use Study, and in this study a computerized system was developed to handle the C.L.I. data. The capability class ratings were converted to quarter section units and coded for computer input. A priority table using the class ratings was established and an optimum renewable resource allocation map was prepared.

The general acceptance of the computer system and methodology led to the creation of a larger and more sophisticated system, and the Municipal Affairs Land Use Planning Data Bank was developed. This data bank and computer system were to be designed so that C.L.I. information for all the quarter sections in Alberta could be stored and retrieved. A number of tests were conducted to control the quality of both the input and output and a computer mapping system was designed for display purposes.

In conjunction with the development of the Land Use Planning Data Bank Alberta Municipal Affairs commenced the preparation of the Hinton-Yellowhead and Lesser Slave Lake regional land use studies. Associated with these two studies was the development of the methodology for the allocation of land according to renewable resource potential. A priority table containing twenty-five levels of allocation, which were based on capability classes, was developed and allocation maps were prepared for the Hinton-Yellowhead and Lesser Slave Lake study areas.

Paralleling the development of the above two indicated studies was The Foothills Resource Allocation Study being prepared by the Alberta Forest Service. The Land Use Planning Data Bank was also used in this study, and the input of data was identical. However, the format of the output and the allocation procedures were different.

In addition to the studies conducted by Municipal Affairs and the Alberta Forest Service, the Land Use Assignment Branch of the Alberta Department of Lands and Forests was engaged in the preparation of biophysical land use studies. The biophysical methodology included the input of the C.L.I. classification data; however, the system was not computerized. The methodology utilized was largely based on the biophysical land classification system developed by G.A. Hills in Ontario.

Since the completion of the major land use studies conducted by Municipal Affairs and the Alberta Forest Service, the utilization of the Canada Land Inventory in Alberta has decreased. The Land Use Planning Data Bank and the allocation procedure developed by Municipal Affairs have been used in country residential surveys and in the analysis of the renewable resource potential of the Cold Lake area, but the sophistication of the methodology is not as great as in the Hinton-Yellowhead and Lesser Slave Lake studies. It is unlikely that the level of analysis, and the use of the capability classifications in land allocation reached in these studies will be obtained in the future.

2. Conclusion

It has been shown that the Canada Land Inventory has had a significant impact upon the patterns of utilization of renewable resources in Canada. Although the classifications have their limitations and constraints it can be said that the program has been a success.

Probably the most important component of the Canada Land Inventory has been the soil capability classification for agriculture, for it is a demonstration of the need for Canadians to conserve our prime and scarce agricultural lands which are rapidly disappearing as a result of urban expansion. Canadians are gradually recognizing the importance of maintaining these highly productive lands for agricultural production. Prior to the development of this classification many believed that Canada had an inexhaustible supply of high quality agricultural lands.

The accuracy of the agricultural capability classes will continue to be challenged, and undoubtedly there are many errors. However, these errors in most cases will be insignificant and involve changes of only one or two classes. Any boundary changes will also be quite insignificant. Research conducted across the country has indicated that definite correlations exist between the agricultural capability ratings and productivity.

A recent example which emphasizes these correlations can be found in the Calgary Region Growth Study - Findings and Recommendations - Final Report prepared in 1977. In this study, productivity figures in bushels of wheat and a productivity index have been developed for the agricultural capability classes.

TABLE 96

PRODUCTIVITY BY CLASS OF LAND - CALGARY REGION

Agricultural Capability Class	Productivity/Acre Bushels of Wheat	Productivity Index
1	25 - 30	1.00
2	20 - 35	.83
3	15 - 20	.67
4	below 15 or forage hay	.50
5	1 ton of hay	-
6	less than one ton of hay	-
7	minimal	-

Source: primary - D. Macpherson, District Agriculturalist, Department of Agriculture, Calgary, personal communication, March 5, 1976.

secondary - Calgary Regional Planning Commission, Calgary Region Growth Study - Findings and Recommendations - Final Report, 1977.

These findings are similar to those developed by Alberta Municipal Affairs in the Lesser Slave Regional Plan and illustrate an additional attempt at quantifying the agricultural-capability classes.

In this study some interesting statistics which document the loss of agricultural land were also provided. In the Calgary area over 11,340 hectares (28,000 acres) of land with agricultural capability ratings of 1 to 3 have been subdivided into parcels under 8.1 hectares (20 acres) in size. The average 1974-75 price of wheat was $4.00 per bushel, and it is estimated that these 11,340 hectares (28,000 acres) could have produced over 600,000 bushels of wheat with a yearly average value of $2,500,000.

It is hoped that the soil capability classification for agriculture will continue to be used in the preparation of rural land use plans and zoning bylaws. In the past there was "a hands off approach" to the zoning of rural lands. Regional planners did not have the knowledge or information to identify high capability agricultural lands. Now the situation has changed. It is also encouraging to know that the public understands the seven class system and will support the preservation of high capability soils. The public has become adequately aware of the importance of this classification. However, this concern could have negative implications as local interests and pressures could hinder the development of conflicting land uses which are broader in scope and are required at a regional or provincial level. Some would argue that this was the situation with the proposed Dodds-Roundhill thermal coal development project which was rejected by the Provincial Government because of local pressure. The benefits accrued from this capability classification alone have justified the development of the Canada Land Inventory.

The land capability classification for recreation has generated considerable interest within government agencies and by the private sector. Of prime importance has been the shoreland component of the classification. Ten years ago our lake and river shorelands were taken for granted; there was enough space for everyone. The situation has now changed and increasing demands have been placed upon the use of our shorelands.

Although the recreation classification is not site specific it does give a good indication of the potential of our shorelands to accommodate various uses. In general terms we are now able to quantify the extent of our beach areas and shorelands suitable for cottages. The shoreland component of the classification has been extremely useful to planning agencies involved in the preparation of regional land use studies. The information has also been employed by the public and private consultants; however, in some cases the information has been misused as it has been treated as being overly site specific and used to justify the approval of cottage subdivision applications. The shoreland classification has also resulted in some land speculation. The upland component of the recreation classification is very general, although some site specific locations for ski hills, waterfalls, etc. have been identified. Such site specific locations are usually documented in recreational and tourism studies where more detail is provided. This upland sector of the classification has received minimal uses by both government agencies and the private sector.

The land capability classification for forestry has provided an overall review of the forestry potential in Canada. The capability class data arefairly specific and reliable. There has been some confusion relative to this classification, however, as many people feel that the maps portray existing tree cover and not the capability of the area to produce timber. The public has difficulty in comprehending forestry classes in an area which for decades has been used for agriculture. Foresters usually require more site specific information than that provided in the classification, and as a result it has not received extensive use by them. The classification, nevertheless, has been extremely useful in the preparation of regional land use studies in fulfilling the requirements for forestry information.

The land capability classifications for ungulates and waterfowl have clearly identified critical lands for the production of wildlife. This is important to resource and regional planners who can zone these lands appropriately but not necessarily exclusively for ungulates. The classification provides the necessary information to justify their decisions. The maps, however, direct hunters to these critical areas, and this could have a detrimental effect on our wildlife resources.

The capability classification of fresh water sport fish has received little use outside of government agencies, and even here the use has been minimal. The classification is more complicated than some of the others, and this problem is intensified because of the lack of coloured 1:250,000 maps. It will be used primarily as a fisheries input to regional land use studies.

The prime utilization of a present land use classification takes place at the time it was produced, and this is the case with the classification prepared under the auspices of the Canada Land Inventory. After this initial utilization a present land use classification is employed primarily in historical analyses. It is likely that the present land use classification will receive minimal use in the immediate future. In subsequent years it will be used for comparative purposes with newly generated present land use studies. However, in any study in which preferred land uses based on capability are determined, the present land use classification provides a realistic base or starting point. The classification is important to our knowledge of resources for it has provided a documentation of land use for the settled areas of Canada at specific points in time.

In future years present land use classifications will probably be done through remote sensing from satellites. In 1978 Canada Environment prepared a report entitled Computer Processing of Landsat Data for Canada Land Inventory Land Use Planning. Methods of analyzing and displaying Landsat data are discussed, and "it is recommended that the Canada Land Inventory classification system be retained for describing the Landsat classes which can be separated using multispectral digital data as a source of current information on land use in Canada."[247]

In a recent paper on remote sensing M. Conitz has indicated some of the future benefits of remote sensing.

> In order to assess the agricultural potential of a given country, planners need to know the suitability or capability of land for various kinds of production. Thus soil mapping and vegetative cover mapping are also high priority needs which can be satisfied more

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[247] Canada, Department of the Environment, Lands Directorate, The Canada Land Inventory, Computer Processing of Landsat Data for Canada Land Inventory Land Use Planning, Report No. 13, 1978, p. 70

> rapidly through the use of Landsat imagery... it has already been demonstrated that Landsat imagery can be effective as a basis for medium and small scale mapping... remote sensing satellites can be applied to survey resources, forecast crops and monitor land use.[248]

As these statements illustrate, the potential of remote sensing is considerably greater than for use alone in present land use classifications.

Individually, each of the classifications has contributed to our knowledge of the inherent character of renewable resources in Canada. Collectively, an even greater awareness has been obtained. One of the most important aspects of regional planning is in the determination and recommendation of resource use for a given land area. In urban areas lands were classed and zoned for a variety of uses; however, this was not the case in rural areas where most lands were simply classed as agricultural. With the Canada Land Inventory planners now have information on the capability for a number of land uses. The problem that was now faced was the determination of the most appropriate land use for a specific area. Methods of resource analysis and allocation would have to be developed, and with the completion of the five main capability classifications research in this regard was initiated across the country.

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[248] M. Conitz, A Development Assistance Program in Remote Sensing, Photogrammetric Engineering & Remote Sensing, Journal of the American Society of Photogrammetry, Volume XLIV, No. 2, February, 1978, pp. 179-180.

The classifications were utilized in the development of resource allocation procedures in Alberta by the Department of Municipal Affairs and the Alberta Forest Service. The renewable resource allocation methodologies developed for the Lesser Slave Lake Regional Plan and the Foothills Resource Allocation Study exemplify the true potential and values of the C.L.I. The procedures developed in these studies would not have been possible without the capability classifications, and it can be said that a major advance in resource analysis has taken place.

Significant progress had also been made in other provinces, and with the development of the Canadian Geographic Information System it was possible to manipulate large amounts of data.

To realize the full potential of these advances it was critical that the results of the allocation processes be incorporated into a decision-making process and implemented through legislation. This process has been slow, but in a few cases the classifications have been incorporated into legislation at the municipal, regional and provincial levels of government.

For those who utilize the Canada Land Inventory there are a number of factors that must be appreciated. It must be remembered that the classifications were conducted at a reconnaissance level and were not intended for site specific planning. Although the degree of detail in each varies considerably, generally it can be said that the classifications are suited to a regional level of analysis. The allocation maps prepared for the Hinton-Yellowhead and Lesser Slave Lake studies have been criticized, as the allocation has been shown by quarter sections. It should be remembered that the quarter section was used primarily as a matter of convenience in the preparation of resource material and any final zoning would be based on much larger land units.

Some of the superior uses of the C.L.I. are illustrated in the allocation methodologies that have been developed. However, it is in this area of analysis that some of the greatest concerns have been expressed. Comparisons between classifications may be difficult to justify since each classification was single purpose in objective and developed according to its own specific criterion. Although it has been assumed in many cases, there is little documentation to indicate that a particular class in one classification is equal to the same class in another.

In speaking on the comparability of the classification ratings W. E. Rees has indicated that

> the C.L.I. system by itself simply does not account for the interrelationships or trade-offs, environmental or social, among the different resource sectors. Each capability map can therefore be described as an independent, static representation of an only more or less objective assessment of the land resource for a single purpose at a particular point in time. In short, the difficult task of interpretations and allocation in the light of contemporary socio-economic conditions is quite properly left to the user - planner.

> In some cases, as between forestry and agriculture, conflict resolutions might be somewhat simplified by reduction of the parallel classifications to a common scale. But what about comparisons involving recreation where pricing is difficult and the ratings prejudicial to certain activities? Is a superb hiking trail in a class 4 recreation area really of less social value than forestry with a class 2 rating for the same area?
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> Clearly this should not be our automatic conclusion - other factors such as the relative scarcity of a particular resource in a particular area must be considered. In short, planners must understand fully the criteria developed for each sector, and the differences between sectors if valid comparisons and trade-offs are to be made (between sectors) in the land allocation process. [249]

The concerns discussed in this paper of W. E. Rees were identified by the Alberta Department of Municipal Affairs in the development of the resource allocation methodology. The priority table with its 25 levels of allocation was based on a provincial perspective including provincial supply of,and demand for,renewable resources. Of course, such a provincial perspective is difficult to justify as we all have our own ideas of what is important. The procedure is further complicated because political,economic, social, environmental and other priorities are continually changing.

It is important to recognize that the capability maps alone do not form the basis for a land use plan. Neither do the allocation or capability analysis maps that have been prepared. The Canada Land

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[249] W. E. Rees, The Canada Land Inventory in Perspective, School of Community and Regional Planning, University of British Columbia, 1977, pp. 17-18.

Inventory can provide only one component in the overall planning process which from necessity must contain socio-economic classifications, et cetera.

The future utilization of the Canada Land Inventory is uncertain. Planning agencies are certainly not using the classification in rural planning studies to the extent that they were several years ago. The use of the Land Use Planning Data Bank and the allocation methodology developed by the Planning Division of Alberta Municipal Affairs is now practically non-existent. The Canadian Geographic Information System is being used primarily by researchers and the results of this research are not being incorporated into decision-making processes of government. The creation of such a system was considered critical in the development of the C.L.I. program. "Unfortunately, the technological capabilities required for the system envisaged by the C.L.I. were still embryonic in the early 1960's and only after nearly 10 years of forced evolution did the C.G.I.S. finally become operational in 1972."[250] By this time it was too late to have a significant impact on C.L.I. research being undertaken in the provinces as many of them had already initiated the development of their own systems. The C.G.I.S. system also appears to have been too sophisticated for many users, in addition to being too sophisticated for the C.L.I. classifications. The generalized classification data did not warrant the use of the precise and complex capabilities of the system. If the Canadian Geographic Information System is to survive, researchers must adapt it to handle information and statistics other than those generated through the Canada Land Inventory. The computer system has probably been the greatest disappointment in the C.L.I. program relative to its intended use.

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[250] Ibid., p. 11.

It is difficult to predict the future use of the individual classifications. The soil capability classification will continue to be utilized until a more reliable and precise classification is developed. The other classifications will undoubtedly be used to a lesser extent.

In some cases the original C.L.I. classifications have been expanded to include more detailed information, as in the Ontario Land Inventory. In British Columbia the land capability classification for recreation has been expanded to include fifty features rather than the original twenty-five.

Parts of the C.L.I. program have also been adapted outside of Canada. In a resource study of the Queanbeyan - Shoalhaven area of the Australian Capital Territory and New South Wales the land capability classification for forestry has been used to indicate forestry potential.

In the 1960's and the first half of the 1970's the emphasis on regional planning was on the preparation of extensive and general land use studies. The Canada Land Inventory was ideally suited to this level of analysis. Now that we have broad based plans, the emphasis is on the preparation of detailed studies for smaller land units, and it is in these studies that the biophysical land classification system may become useful.

> Early in the C.L.I. program the need was perceived for land inventory and classification systems based on and displaying the biological and physical (geoclimate) features of the land resource, without any particular land use. Some sort of descriptive analysis of the resource base is of course implicit in the C.L.I. land capability classification system, but the necessity of an explicit, systematic, base-line inventory for classification purposes emerged only after the capability mapping program was underway in different parts of the country.[251]

Undoubtedly such a base-line inventory will be useful; however, regional planners are more concerned with potential land uses than with inherent characteristics of the land base, and it is in this regard that the capability maps have been of most use.

A question that is now often asked is how successful has the Canada Land Inventory been? With the signing of the ARDA agreement in 1961 it was indicated that the inventory was designed to be used in regional and resource planning. These objectives have certainly been met. Initial expectations were very high and obviously some of the specific objectives have not been realized.

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[251] Ibid., pp. 9, 10.

> The C.L.I. was launched with great enthusiasm and lofty aspiration...Under these circumstances it is hardly surprising that the myriad conceptual, technical, constitutional and communication problems that subsequently emerged have resulted in a certain disillusionment and something of a critical backlash. However, this should not be allowed to obscure the positive aspects of the program.[252]

There certainly have been numerous positive aspects of the C.L.I. Regional and resource planning in Canada has been recognized as an important component of the overall planning process. Planners now have comprehensive resource data to include in their regional planning studies.

Information from the Canada Land Inventory is now included in provincial regulations and legislation on land use. The Canadian people have become aware of the nation's supply of renewable resources and of their quality.

There is one final indirect benefit that should not be forgotten. Many of the young university students who were initially employed in C.L.I. programs now hold responsible positions with resource consultants, regional planning commissions and government departments. In Alberta, key management positions in the Departments of Energy and Natural Resources, Environment, Recreation, Parks and Wildlife, Business Development and Tourism and Municipal Affairs are now held by persons who obtained their initial training and experience in various aspects of the Canada Land Inventory. Resource legislation in Alberta obviously is being and will continue to be influenced by these people.

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[252] Ibid., pp. 35, 36.

The concerns expressed by the Senate's Special Committee on Land Use in 1957 and at the Resources for Tomorrow Conference in 1961, have been acknowledged. The Canada Land Inventory has 'placed its mark' on resource planning in Canada.

However, we cannot stop here, the process must continue.

BIBLIOGRAPHY

ACRES, H. G. & COMPANY LTD., Mactaquac Regional Development Plan, Summary Report, The New Brunswick A.R.D.A. Committee March, 1965.

ALASKA, DEPARTMENT OF NATURAL RESOURCES, Division of Lands, Parks and Recreation Section, Cresap, McCormick & Paget Inc., Alaska Outdoor Recreation Plan, 1970.

ALBERTA, DEPARTMENT OF AGRICULTURE, Resource Economics Branch, Agriculture Input, Clear River Study Area, W. S. Pattison, August, 1973.

ALBERTA, DEPARTMENT OF AGRICULTURE, Resource Economics Branch, Agricultural Real Estate Values in Alberta, 1976 and 1977.

ALBERTA, DEPARTMENT OF AGRICULTURE, correspondence from A. W. Goettel, Head, Soils Branch to S. J. Collins, Provincial Planning, Municipal Affairs, May 21, 1974.

ALBERTA, DEPARTMENT OF AGRICULTURE, correspondence from J. Knapp, Resource Economics Branch to S. J. Collins, Provincial Planning, Municipal Affairs, May 2, 1974.

ALBERTA, DEPARTMENT OF AGRICULTURE, Resource Economics Branch, Rural Real Estate Values in Alberta, April, 1972.

ALBERTA, DEPARTMENT OF ENERGY AND NATURAL RESOURCES, A Coal Development Policy for Alberta, 1976.

ALBERTA, DEPARTMENT OF ENERGY AND NATURAL RESOURCES, Land Capability Classification for Forestry in Alberta, E.N.R. Report No. 6, 1976.

ALBERTA, DEPARTMENT OF ENERGY AND NATURAL RESOURCES, Land Use Management Aspects of Coal Development, Report of Task Force III to Coal Development Steering Committee, 1976.

ALBERTA, DEPARTMENT OF ENERGY AND NATURAL RESOURCES, Plan Alternatives for the Kananaskis/Spray Lakes, Management Plan, 1977.

ALBERTA, DEPARTMENT OF ENERGY AND NATURAL RESOURCES, Technical Division, Land Use Assignment Section, Biophysical Analysis and Evaluation of Capability-Clear River Area, 1976.

ALBERTA, DEPARTMENT OF ENVIRONMENT, Cooking Lake Area Study, Planning Report, Volume 1, 1977.

ALBERTA, DEPARTMENT OF ENVIRONMENT, Conservation and Utilization Committee, *Minutes of 122 Meeting*, September 11, 1973.

ALBERTA, DEPARTMENT OF THE ENVIRONMENT, *Lake Capacity - Literature Survey and Review*, prepared for the Conservation and Utilization Committee, 1973.

ALBERTA, DEPARTMENT OF THE ENVIRONMENT, *Land Conservation Guidelines*, Appendix I, Land Conservation & Reclamation Division, 1972.

ALBERTA, DEPARTMENT OF THE ENVIRONMENT, *The Land Surface Conservation and Reclamation Act*, Land Conservation Regulations, Schedule, Land Conservation Guidelines, OC 815/74.

ALBERTA, DEPARTMENT OF THE ENVIRONMENT, *correspondence* from H. W. Thiessen, Assistant Deputy Minister, Environmental Co-ordination Services, to N. Dant, Director Provincial Planning, Municipal Affairs, May 31, 1974.

ALBERTA, DEPARTMENT OF THE ENVIRONMENT, *The Resources of the Foothills: A Choice of Land Use Alternatives*, prepared for Environment Conservation Authority by The Conservation and Utilization Committee, Task Force on the East Slopes Hearings, 1973.

ALBERTA, DEPARTMENT OF LANDS AND FORESTS, Fish and Wildlife Division, *correspondence* from G. R. Kerr, Chief Wildlife Biologist, to J. Markovich, Supervisor of Special Land Uses, September 1, 1970.

ALBERTA, DEPARTMENT OF LANDS AND FORESTS, *Foothills Resource Allocation Study, Kananaskis-Spray Drainage District*, *Phase One, Preliminary Analysis*, 1972.

ALBERTA, DEPARTMENT OF LANDS AND FORESTS, Forest Inventory Surveys Section, *correspondence* from J. J. Lowe to F. W. McDougall, Head Timber Management Branch, Alberta Forest Service, November 6, 1973.

ALBERTA, DEPARTMENT OF LANDS AND FORESTS, Forest Land Use Branch, *The Foothills Resource Allocation Study, Phase I, Upper Brazeau Drainage District*, 1973.

ALBERTA, DEPARTMENT OF LANDS AND FORESTS, Lands Division, C. W. Harke, *Sturgeon Lake Study Review*, 1973.

ALBERTA, DEPARTMENT OF LANDS AND FORESTS, Land Use Assignment Branch, Biophysical Analysis and Evaluation of Capability Edson - Peers, 1973.

ALBERTA, DEPARTMENT OF LANDS AND FORESTS, Land Use Assignment Branch, Biophysical Analysis and Evaluation of Capability Kananaskis-Spray Drainage District, December,1972.

ALBERTA, DEPARTMENT OF LANDS AND FORESTS, Land Use Assignment Branch, Birch Hills Land Use Study, 1974.

ALBERTA, DEPARTMENT OF LANDS AND FORESTS, Land Use Assignment Committee, Kananaskis-Spray Drainage District Land Use Plan, Recommendations to the Deputy Minister, June,1973.

ALBERTA, DEPARTMENT OF LANDS AND FORESTS, Land Use Assignment Committee, McLeod River Brown Zone Study, 1969.

ALBERTA, DEPARTMENT OF LANDS AND FORESTS, Land Use Assignment Committee, Puskaskau Land Use Plan, 1971.

ALBERTA, DEPARTMENT OF LANDS AND FORESTS, Land Use Assignment Section, Biophysical Analysis and Evaluation of Capability, Snipe Lake Area, 1975.

ALBERTA, DEPARTMENT OF LANDS AND FORESTS, Land Use Assignment Section, Manual of Biophysical Land Classification and Evaluation of Capability, 1974.

ALBERTA, DEPARTMENT OF LANDS AND FORESTS, correspondence from T. A. Drinkwater, Director of Parks to N. Dant, Director Provincial Planning, Municipal Affairs, June 6, 1974.

ALBERTA, DEPARTMENT OF LANDS AND FORESTS, correspondence from T. A. Drinkwater, Director, Technical Division to N. Dant, Director, Provincial Planning, Municipal Affairs, October 19, 1970.

ALBERTA, DEPARTMENT OF LANDS AND FORESTS, correspondence from J. R. Harrower, Director, Technical Division to R. G. Steele, Deputy Minister, Lands and Forests, June 6, 1974.

ALBERTA, DEPARTMENT OF LANDS AND FORESTS, correspondence from G. R. Kerr, Director, Fish & Wildlife to N. Dant, Director, Provincial Planning, Municipal Affairs, May 22, 1974.

ALBERTA, DEPARTMENT OF LANDS AND FORESTS, correspondence from F. W. McDougall, Head, Timber Management Branch to R. G. Steele, Director of Forestry, August 26, 1970.

ALBERTA, DEPARTMENT OF LANDS AND FORESTS, correspondence from G. M. Smart, Head, Forest Land Use Branch to N. Dant, Director, Provincial Planning, Municipal Affairs, June 7, 1974.

ALBERTA, DEPARTMENT OF LANDS AND FORESTS, correspondence from H. R. Winn, Forest Superintendent, Slave Lake to N. Dant, Director, Provincial Planning, Municipal Affairs, May 21, 1974.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Assessment Branch, Farms Land Assessment Manual.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Annual Report-1970, 1971.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Annual Report-1971, 1972.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Planning Services Division, Baptiste Lake, A Preliminary Management Plan, 1977.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Planning Services Division, Cold Lake Oil Sands Sub-regional Study, 1978.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Planning Services Division, County of Athabasca Country Residential Study, Part One, 1973.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Planning Services Division, Historical and Physical Setting - Lesser Slave Lake Regional Plan, 1977.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Planning Services Division, Hinton-Yellowhead Regional Land Use Study, Allocation of Land According to Renewable Resource Potential, 1975.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Planning Services Division, Lesser Slave Lake Regional Plan, Section V, Rural Land Use Zoning Map, 1976.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Planning Services Division, Moose Lake Management Plan, 1977.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Planning Services Division, Provincial Land Use Policies - Background Paper, 1976.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Planning Services Division, The Lakeland Region, Regional Lake Classification, 1978.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Planning Services Division, Slave Lake Area Country Residential Study, 1976.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Planning Services Division, The Optimum Renewable Resource Potential of Alberta Coal Fields and Isolated Coal Deposits, 1976.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Provincial Planning Branch, A Brief Discussion on Establishing Priorities in Planning, unpublished report, 1972.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Provincial Planning Branch, Allocation of Land According to Renewable Resource Potential, Lesser Slave Lake Regional Plan, Rural Land Use Study, Section III, April, 1974.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Provincial Planning Branch, A User - Orientated Summary and Description of the Data Base Data Processing System and Computerized Document Retrieval System Employed in Regional Land Use Studies, 1971.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Provincial Planning Branch, C.L.I. Recreation Capability Inventory, unpublished report, No. 1, 1972.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Provincial Planning Branch, C.L.I. Agriculture Capability, unpublished report, No. 2, 1972.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Provincial Planning Branch, C.L.I. Present Land Use, unpublished report, No. 3, 1972.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Provincial Planning Branch, C.L.I. Sport-Fish Capability Classification, unpublished report No. 4, 1972.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Provincial Planning Branch, C.L.I. Waterfowl Capability Analysis, unpublished report No. 5, 1972.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Provincial Planning Branch, C.L.I. Ungulate Capability Analysis, unpublished report, No. 6, 1972.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Provincial Planning Branch, C.L.I. Land Capability for Forestry, unpublished report, No. 7, 1972.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Provincial Planning Branch, Evaluation and Planning Alternatives, Kananaskis-Spray Drainage District Phase I, August 1972.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Provincial Planning Branch, Land Use and Resource Development in the Eastern Slopes, Athabasca-Yellowhead Area, report to the Alberta Environment Conservation Authority, Bulletin No. 9, 1973.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Provincial Planning Branch, Recreational Development at Gregoire Lake, May, 1969.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Provincial Planning Branch, Proposed Regulations for the Location and Development of Cottage Subdivisions, 1972.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Provincial Planning Branch, Report of the Task Force on the Subdivision of Land Adjacent to Water Bodies, 1973.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Provincial Planning Branch, Peers-Whitecourt Land Use Study, 1970.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Provincial Planning Branch Peers-Whitecourt Land Use Study, A Critique by Ken Wilson, February, 1972.

ALBERTA, DEPARTMENT OF MUNICIPAL AFFAIRS, Provincial Planning Branch, The Priority Table, 1973.

ALBERTA, ENVIRONMENT CONSERVATION AUTHORITY, correspondence from B. Sadler to H. L. Hogge, June 5, 1976.

ALBERTA GEOGRAPHICAL SOCIETY, Land and Water Resource Development in the Eastern Slopes, brief submitted to Environment Conservation Authority, prepared by Dr. A. H. Laycock, July, 1973.

ALBERTA, GOVERNMENT, Alberta Land Use Forum, Order in Council No. 1447/73, October 1, 1973, cited in *Land Use Forum Report and Recommendations*, January, 1976.

ALBERTA, GOVERNMENT, *A Policy for Resource Management of the Eastern Slopes*, 1977.

ALBERTA, GOVERNMENT, Land Use Forum, *Future Land Needs for Agriculture*, Technical Report No. 5, prepared by Hu Harries and Associates Ltd., 1974.

ALBERTA, GOVERNMENT, Land Use Forum, *Report and Recommendations*, 1976.

ALBERTA, GOVERNMENT, Land Use Forum, *Use of Our Lakes and Lake Shore Lands*, Technical Report No. 12, 1974.

ALBERTA, GOVERNMENT, Land Use Planning Technical Co-ordinating Committee, *Minutes*, October 20, 1970.

ALBERTA, GOVERNMENT, Land Use Planning Technical Co-ordinating Committee, *Minutes*, March 8, 1971.

ALBERTA, GOVERNMENT, *The Planning Act*, Chapter 276 of the Revised Statutes of Alberta, 1970, Part 3 Regional Planning, Regional Plans, Section 68.

ALBERTA, GOVERNMENT, *The Planning Act*, Chapter 89, Part 3, Regional Plans and Statutory Plans, 1977.

ALBERTA,HUMAN RESOURCES RESEARCH COUNCIL, *Data Bank - Towards the Development of Socio-Political Data Bank for Alberta*, 1971.

ALBERTA,RESEARCH COUNCIL, *correspondence* from R. Green, Chief Earch Sciences Branch to S. J. Collins, Provincial Planning, Municipal Affairs, May 31, 1974.

ALBERTA, RESEARCH COUNCIL, *Soil Survey and Land Evaluation in the Hinton-Edson area*, Report No. 31, Alberta Soil Survey, 1972.

ALBERTA, RESEARCH COUNCIL, *Soil Survey of the Chip Lake Area*, Report No. 28, Alberta Soil Survey, 1971.

ALBERTA, TASK FORCE ON URBANIZATION & THE FUTURE, *The Role of Regional Planning*, 1971.

ALBERTA, UNIVERSITY, Alberta Institute of Pedology, Land Classification and Soils in the Rocky Mountains of Alberta Along the North Saskatchewan River Valley, 1971.

ALBERTA, UNIVERSITY, College of Agriculture, Soil Survey of Lethbridge and Pincher Creek Sheets, Bulletin Number 32, July, 1934.

ALBERTA, UNIVERSITY, College of Agriculture, Soil Survey of Sounding Creek Sheet, Bulletin Number 16, December, 1922.

ALBERTA, UNIVERSITY, Computer Centre, Calcomp Plotter, Calcomp User's Manual, February, 1970.

ALTENBERG, Carl, Consent Policies and Zoning for Rural Land Use, Municipal World, October, 1975.

ANDERSON, D. L., The Recreational Capability and Use of Wabamum Lake and the Eastern Half of Lesser Slave Lake, M. A. Thesis, University of Alberta, 1967.

ANON, Correspondence to Department of Regional Economic Expansion from Canada Land Inventory Provincial Co-ordinators, 1969.

ANON, Potential Uses of Canada Land Inventory Information in Manitoba, Part II, 1969.

AUSTRALIA, COMMONWEALTH SCIENTIFIC & INDUSTRIAL RESEARCH ORGANIZATION, Lands of the Queanbeyan - Shoalhaven Area, A.C.T. & N.S.W., Land Research Series No. 24, 1969.

BAILEY, R. G., Land-Capability Classification of the Lake Tahoe Basin, California-Nevada, A Guide for Planning, U. S. Department of Agriculture, 1974.

BAIN, G.K., & SINCLAIR, M. H., Provincial Land Use Mapping, Annual Meeting of the Canadian Association of Geographers, McMaster University, Hamilton, Ontario, 1962.

BAKER, W. M., "Assessing and Allocating Renewable Resources for Recreation", Resources for Tomorrow, Conference Background Papers, Volume 2, 1961.

BAKER, W. M., Tourist and Recreation Patterns and Prospects, Lesser Slave Lake Special Area, prepared for A.R.D.A., 1971.

BARNETT, HAROLD J., & CHANDLER, MORSE, Scarcity and Growth, The Economics of Natural Resource Availability, Resources for the Future, 1962.

BATTLE RIVER REGIONAL PLANNING COMMISSION, The Battle Lake Study, Battle River Regional Planning Commission, Alberta, 1974.

BATTLE RIVER REGIONAL PLANNING COMMISSION, correspondence from R. H. Riddett to N. Dant, Director, Provincial Planning, Department of Municipal Affairs, June 5, 1974.

BATTLE RIVER REGIONAL PLANNING COMMISSION, Miquelon Lakes Planning Report, Battle River Regional Planning Commission, Alberta, 1973.

BATTLE RIVER REGIONAL PLANNING COMMISSION, Pigeon Lake - Planning a Recreational Resource, 1966.

BATTLE RIVER REGIONAL PLANNING COMMISSION, The Preliminary Regional Plan, 1976.

BENSON, W. A., Demands for the Land, Canadian Council of Resource and Environment Ministers, Land Seminar, Fredericton, N. B., 1972.

BERGEVIN, J. B., Gaspe: A Case Study in Regional Planning, Canadian Public Administration, 1966.

BLUMENFELD, HANS, The Conceptual Framework of Land Use, Annual Meeting of the Canadian Association of Geographers, McMaster University, Hamilton, Ontario, 1962.

BOUDEVILLE, J. R., Problems of Regional Economic Planning, Edinburgh, Edinburgh University Press, 1966.

BOURASSA, GUY, Canadian Council on Rural Development, Study On Participation and Regional Planning, October, 1969.

BOWSER, W. E., Agro-Climatic Areas of Alberta, Canada Department of Agriculture and Alberta Soil Survey, 1967.

BREWIS, T. N. & PAQUET, G., Regional Development and Planning in Canada, Canadian Public Administration, 1968.

BREWIS, T. N., *Regional Economic Policies in Canada*, Macmillan Co., Toronto, 1969.

BRITISH COLUMBIA, A.R.D.A. COMMITTEE, C.L.I., *Land Capability Analysis East Kootenay Area*, 1970.

BRITISH COLUMBIA, A.R.D.A. COMMITTEE, Canada Land Inventory, *Land Capability Analysis of the Prince George Special Sales Area*, 1969.

BRITISH COLUMBIA, GOVERNMENT, *Land Commission Act*, 1973.

BRITISH COLUMBIA, GOVERNMENT, Land Commission, *Keeping the Options Open*, 1975.

BROOKS, L., *Demands of Forest Recreation on the Forester and Our Forest Resource*, Forestry Chronicle, Volume 40, 1964.

BROWN, W. G. E., *Land Classification and Zoning*, Forestry Chronicle, Volume 39, 1963.

BROWN, C. S., *New Approaches to Forest Recreation Planning in Canada*, The Forestry Chronicle, June 1968.

BROWN, C. S., *Recreation Land Inventory in Saskatchewan*, 1964 Experience and 1965 Proposals, 1964.

BUCKLEY, H., & TIHANYI, E., *Canadian Policies for Rural Adjustment*: A Study of the Economic Impacts of the ARDA, PFRA, and MMRA Programs, Ottawa, Queen's Printer, 1967.

BURGAR, R. J., *A Proposal for Wilderness Areas, Nature Reserves and Forestry in the Kenora Forest District*, Forestry Chronicle, Volume 46, 1970.

BURTON, THOMAS L., *Natural Resource Policy in Canada, Issues and Perspectives*, McClelland and Steward Limited, Toronto, 1972.

CALGARY REGIONAL PLANNING COMMISSION, *Canmore Corridor, River Shorelands Pilot Study* (draft),May, 1977.

CALGARY REGIONAL PLANNING COMMISSION, *Findings and Recommendations, Calgary Region Growth Study*, 1977.

CALGARY REGIONAL PLANNING COMMISSION, *Lakes and Lake Shorelands Study*, August, 1974.

CALGARY REGIONAL PLANNING COMMISSION, Land Use and Resource Development in the Eastern Slopes, Bow River Watershed Basin, report to the Alberta Environment Conservation Authority, Information Bulletin No. 6, 1973.

CALGARY REGIONAL PLANNING COMMISSION, Physical Characteristics, summary and technical bulletins - Calgary Region Growth Study, 1977.

CANADA COMMISSION OF CONSERVATION, Report of the Fourth Annual Meeting, Ottawa, 1913.

CANADA, DEPARTMENT OF AGRICULTURE, Cardston Region of Alberta, Prairie Regional Studies in Economic Geography No. 9, 1972.

CANADA, DEPARTMENT OF AGRICULTURE, The Canmore-Vegreville Region of Alberta, Prairie Regional Studies in Economic Geography No. 4, 1969.

CANADA, DEPARTMENT OF AGRICULTURE, Land Use Classification in the Special Areas of Alberta, Technical Bulletin, No. 39, 1942.

CANADA, DEPARTMENT OF AGRICULTURE, The Soil Classification for Canada, 1970.

CANADA, DEPARTMENT OF ENERGY MINES AND RESOURCES, A Guide in the Classification of Land Use for the Canada Land Inventory, 1968.

CANADA, DEPARTMENT OF ENERGY MINES AND RESOURCES, Perception and Attitudes in Resources Management, ed., W. R. D. Sewell and I. Burton, Policy Research and Co-ordination, 1971.

CANADA, DEPARTMENT OF THE ENVIRONMENT, Canada Land Inventory, Land Capability Analysis, Outaouais Region, Quebec, 1972.

CANADA, DEPARTMENT OF THE ENVIRONMENT, Canada Land Inventory, Land Capability for Forestry, 1:1,000,000 map, Alberta, 1976.

CANADA, DEPARTMENT OF THE ENVIRONMENT, Canada Land Inventory, Land Capability for Recreation, 1:1,000,000 map, Alberta, 1975.

CANADA, DEPARTMENT OF ENVIRONMENT, Canada Land Inventory, Land Capability for Recreation, Tawatinaw 831, 1971.

CANADA, DEPARTMENT OF THE ENVIRONMENT, Canada Land Inventory, Land Capability for Ungulates, 1:1,000,000 map, Alberta, 1976.

CANADA, DEPARTMENT OF THE ENVIRONMENT, Canada Land Inventory, Land Capability for Waterfowl, 1:1,000,000 map, Alberta, 1974.

CANADA, DEPARTMENT OF THE ENVIRONMENT, Canada Land Inventory, Soil Capability for Agriculture, 1:1,000,000 map, Alberta, 1976.

CANADA, DEPARTMENT OF THE ENVIRONMENT, Canadian Forestry Service, Northern Forest Research Centre, Remote Sensing, Forestry Report, Volume 3, No. 3, 1973.

CANADA, DEPARTMENT OF THE ENVIRONMENT, Canadian Wildlife Service, correspondence from C. D. Schick to S. J. Collins, Provincial Planning, Municipal Affairs, May 21, 1974.

CANADA, DEPARTMENT OF THE ENVIRONMENT, Canadian Wildlife Service, Transactions of the Thirty-Fifth Federal-Provincial Wildlife Conference held in Toronto, July 6-8, 1971. J. W. Maxwell - "Land Use and the Planning Process".

CANADA, DEPARTMENT OF THE ENVIRONMENT, Forest Resources and Utilization in Canada to the Year 2000, 1971.

CANADA, DEPARTMENT OF THE ENVIRONMENT, Lands Directorate, Canada's Northlands - Proceedings of Technical Workshop. To develop an integrated approach to base data inventories for Canada's northlands, 1974.

CANADA, DEPARTMENT OF THE ENVIRONMENT, Lands Directorate, C.L.I., Alberta: Critical Capability Areas, map, 1975.

CANADA, DEPARTMENT OF THE ENVIRONMENT, Lands Directorate, C.L.I., Computer Processing of Landsat Data for Canada Land Inventory Land Use Planning, Report No. 13, 1978.

CANADA, DEPARTMENT OF THE ENVIRONMENT, Lands Directorate The Determinants of Land Capability, by M. F. Goodchild, University of Western Ontario, 1976.

CANADA, DEPARTMENT OF THE ENVIRONMENT, Lands Directorate, Landowners and Land Use in the Musquodoboit Valley, Nova Scotia, 1974.

CANADA, DEPARTMENT OF THE ENVIRONMENT, Lands Directorate, Land Capability for Agriculture, Canada Land Inventory, A Preliminary Report, 1976.

CANADA, DEPARTMENT OF THE ENVIRONMENT, Lands Directorate, *Land Use Planning Programs in Canada, Prince Edward Island*, 1974.

CANADA, DEPARTMENT OF THE ENVIRONMENT, Lands Directorate, "National Land Use Policy called for in Environment Week", *News Release*, Ottawa, 10/7/75.

CANADA, DEPARTMENT OF THE ENVIRONMENT, Lands Directorate, *News Release*, Environment Canada Computer System to be used by U. S. Government Agency, 1975.

CANADA, DEPARTMENT OF THE ENVIRONMENT, Lands Directorate, *Rural Land Use Changes in the Ottawa-Hull Urban Region* by D. M. Gierman, Occasional Paper, No. 9, 1976.

CANADA, DEPARTMENT OF FISHERIES AND ENVIRONMENT, Lands Directorate, C.L.I., *Agricultural Land and Urban Centres*, Report No. 11, 1977.

CANADA, DEPARTMENT OF FISHERIES AND ENVIRONMENT, Lands Directorate, *Rural to Urban Land Conversion*, Occasional Paper, No. 16, 1977.

CANADA, DEPARTMENT OF FISHERIES AND FORESTRY, Canadian Forestry Services, *Guidelines for Bio-Physical Land Classification*, Ottawa, 1969.

CANADA, DEPARTMENT OF FORESTRY, A.R.D.A., Canada Land Inventory, *Aid to the Classification of Ski Areas*, 1966.

CANADA, DEPARTMENT OF FORESTRY, A.R.D.A. Canada Land Inventory, *Biophysical Land Classification Pilot Projects* - Progress Report, April 1968.

CANADA, DEPARTMENT OF FORESTRY, A.R.D.A., Canada Land Inventory, *Proceedings of the Atlantic Regional Meeting Recreation Capability - C.L.I.*, Kedgwick, New Brunswick, July, 1966.

CANADA, DEPARTMENT OF FORESTRY, A.R.D.A., Canada Land Inventory, *Soil Capability Classification for Agriculture*, Report No. 2, 1965.

CANADA, DEPARTMENT OF FORESTRY, A.R.D.A., Canada Land Inventory, *Western Region Meeting Recreation Sector*, Victoria, B.C., April, 1967.

CANADA, DEPARTMENT OF FORESTRY, *The ARDA Catalogue, 1962-1965*, Ottawa, 1965.

CANADA, DEPARTMENT OF FORESTRY, *The ARDA Catalogue*, 1965-66, Ottawa, 1966.

CANADA, DEPARTMENT OF FORESTRY, A.R.D.A., *Federal-Provincial Rural Development Agreement 1965-1970,* 1966.

CANADA, DEPARTMENT OF FORESTRY, *A.R.D.A. - Projects of Research Rural Development, Alternate Land Use Community Pastures, Soil and Water Conservation to March 31, 1964*, June, 1964.

CANADA, DEPARTMENT OF FORESTRY, *A.R.D.A. Regional Land Inventory Seminars*, Background Papers on Objectives and Methods of Inventory, 1964.

CANADA, DEPARTMENT OF FORESTRY, Canada Land Inventory, *Classfication of Land Capability for Recreation: Interim Manual to Guide Pilot Projects in 1965*, 1965.

CANADA, DEPARTMENT OF FORESTRY & RURAL DEVELOPMENT, Rural Development Branch, *A.R.D.A. Annual Report, 1965-66*, 1966.

CANADA, DEPARTMENT OF FORESTRY & RURAL DEVELOPMENT, Rural Development Branch, *A.R.D.A. Annual Report, 1966-67*, 1967.

CANADA, DEPARTMENT OF FORESTRY & RURAL DEVELOPMENT, *The A.R.D.A. Catalogue 1966-67,* Ottawa, 1967.

CANADA, DEPARTMENT OF FORESTRY AND RURAL DEVELOPMENT, *The A.R.D.A. Catalogue 1967-68*, Ottawa, 1968.

CANADA, DEPARTMENT OF FORESTRY & RURAL DEVELOPMENT, A.R.D.A., *Life & Poverty in the Maritimes*, Pierre-Yves Pepin, 1968.

CANADA, DEPARTMENT OF FORESTRY & RURAL DEVELOPMENT, A.R.D.A., *Partners in Progress*, Queen's Printer, Ottawa, 1966.

CANADA, DEPARTMENT OF FORESTRY & RURAL DEVELOPMENT, Canada Land Inventory, A.R.D.A., *Field Manual Land Capability Classification for Outdoor Recreation*, June, 1967.

CANADA, DEPARTMENT OF FORESTRY AND RURAL DEVELOPMENT, *Development Plan for the: Pilot Region: Lower St. Lawrence, Gaspe and Iles-De-La-Madeleine-A Summary*, Bureau D'amenagement de l'est Due Quebec (BAEQ), 1967.

CANADA, DEPARTMENT OF FORESTRY & RURAL DEVELOPMENT, Forest Research Laboratory, Calgary, *A Forest Land Capability Classification for the Marsh Head Demonstration Area Whitecourt Forest, 1967*.

CANADA, DEPARTMENT OF FORESTRY & RURAL DEVELOPMENT, *Proceedings - National Committee on Forest Land*, Forestry Branch, 1967.

CANADA, DEPARTMENT OF FORESTRY & RURAL DEVELOPMENT, *Regional Planning for Depressed Rural Areas - The Canadian Experience*, 1968.

CANADA, DEPARTMENT OF INDIAN AND NORTHERN AFFAIRS, *Environmental Analysis, A Review of Selected Techniques*, 1973.

CANADA, DEPARTMENT OF MINES & TECHNICAL SURVEYS, Geographical Branch, *Canadian Land Use Mapping*, Geographical Paper No. 31, 1961.

CANADA, DEPARTMENT OF MINES AND TECHNICAL SURVEYS, Geographical Branch, *Land Use Classification, A Guide for Field Officers*, 1962.

CANADA, DEPARTMENT OF MINES & TECHNICAL SURVEYS, Geographical Branch, *Procedure for Production of Land Use Maps*, 1962.

CANADA, DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES, Agriculture Workshop B, "Adjustments on Land in Agriculture, Review and Conclusions", *Resources for Tomorrow, Conference Proceedings*, Volume 3, 1962.

CANADA, DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES, Forestry Workshop B, Discussion, *Resources for Tomorrow Conference Proceedings*, Volume 3, 1962.

CANADA, DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES, Recreation Workshop B, Discussion, *Resources For Tomorrow, Conference Proceedings*, Volume 3, 1962.

CANADA, DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES, Research Workshop A, Discussion, *Resources for Tomorrow, Conference Proceedings*, Volume 3, 1962.

CANADA, DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES, Research Workshop B, Discussant, J. L. Robinson, *Resources for Tomorrow, Conference Proceedings*, Volume 3, 1962.

CANADA, DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES, Statements by Research Co-ordinators, Joint Statement, *Resources for Tomorrow, Conference Proceedings*, Volume 3, 1962.

CANADA, DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES, Wildlife Workshops A and B, Joint Meeting, Discussion, *Resources for Tomorrow, Conference Proceedings*, Volume 3, 1962.

CANADA, DEPARTMENT OF REGIONAL ECONOMIC EXPANSION, The Canada Land Inventory, Ottawa, *A Guide for Resource Planning*, 1970.

CANADA, DEPARTMENT OF REGIONAL ECONOMIC EXPANSION, C.L.I., *Guidelines for Mapping Land Capability for Forestry*, 1970.

CANADA, DEPARTMENT OF REGIONAL ECONOMIC EXPANSION, Canada Land Inventory, *Landowners and Land Use in the Tantramar Area, New Brunswick*, C.L.I. Report No. 9, 1971 and Policy Research and Co-ordination Branch, Department of Energy and Natural Resources, Geographical Paper No. 47, 1971.

CANADA, DEPARTMENT OF REGIONAL ECONOMIC EXPANSION, The Canada Land Inventory, *Land Capability Classification for Forestry*, Report No. 4, Second Edition, 1970.

CANADA, DEPARTMENT OF REGIONAL ECONOMIC EXPANSION, Canada Land Inventory, *Land Capability Classification for Wildlife*, Report No. 7, 1968.

CANADA, DEPARTMENT OF REGIONAL ECONOMIC EXPANSION, The Canada Land Inventory, *Objectives, Scope and Organization*, Report No. 1, 1965, Second Edition, 1970.

CANADA, DEPARTMENT OF REGIONAL ECONOMIC EXPANSION,C.L.I., *Outline of the Canada Land Capability Classification for Wildlife*, Ottawa, 1969.

CANADA, DEPARTMENT OF REGIONAL ECONOMIC EXPANSION, Canada Land Inventory, *Soil Capability Analysis for Agriculture in Nova Scotia*, Report No. 8, 1970.

CANADA, DEPARTMENT OF REGIONAL ECONOMIC EXPANSION, *correspondence* from P. B. Dean,Land Use Planning Co-ordinator, C.L.I. to W. W. Warren, Head Reserach Division, Alberta Municipal Affairs, March 24, 1971.

CANADA, DEPARTMENT OF REGIONAL ECONOMIC EXPANSION, *Towards Integrated Resource Management*, Report of the Sub-Committee on Multiple Use, National Committee on Forest Land, 1969.

CANADA, DOMINION BUREAU OF STATISTICS, *Data Assembly: Geocoding by Small Areas*, 1969.

CANADA, GOVERNMENT, *Agricultural Rehabilitation and Development Act*, June, 1961.

CANADA, GOVERNMENT, *Department of Regional Economic Expansion Act*, 1970.

CANADA, GOVERNMENT, *Hansard, Volume 1*, 1960-61.

CANADA, SENATE, *Proceedings of the Special Committee on Land Use in Canada*, 1957.

CANADA, SENATE, *Report of the Special Committee on Land Use in Canada*, 1964.

CANADA, SASKATCHEWAN, MANITOBA, *Report of the Qu'Appelle Basin Study Board*, Queen's Printer, Regina, 1972.

CANADIAN ASSOCIATION OF GEOGRAPHY, *Essays on Land Use*, Annual Meeting of the Canadian Association of Geographers, McMaster University, 1962.

CANADIAN COUNCIL OF RESOURCE & ENVIRONMENT MINISTERS, *Land Seminar - Secretary's Summary Report*, September, 1972.

CANADIAN COUNCIL ON RURAL DEVELOPMENT, *A.R.D.A. An Experiment in Development Planning*, G. J. N. McCrorie, 1968.

CANADIAN COUNCIL ON RURAL DEVELOPMENT, *Second Report & Review - Some Major Problems of Regional Development*, Ottawa, 1968.

CANADIAN FEDERATION OF AGRICULTURE, *Agricultural Resources for Tomorrow*, Ottawa, 1963.

CANADIAN INSTITUTE OF FORESTRY - Rocky Mountain Section, Alberta: *Forestry and Regional Planning in a Land Use Policy for Alberta*, 1956.

CAPITAL REGIONAL DISTRICT BRITISH COLUMBIA, *An Inventory of Land Resources & Resource Potentials*, ed., C. V. Stanley-Jones and W. A. Benson, May, 1973.

CHAPIN, F. S. JR., Urban Land Use Planning, University of Illinois Press, Urbana, 1965.

CLAWSON, M., HEID, R. B., & STODDARD, A.G., Land for the Future, John Hopkins Press for Resources for the Future, 1960.

CLEPPER, H., Origins of American Conservation, The Ronald Press, New York, 1966.

COLEMAN, D., AND NCNAUGHTON, I., Environmental Planning in Waterloo County ,The Waterloo County Area Selected Geographical Essays, 1971.

CONITZ, M., A Development Assistance Program in Remote Sensing, Photogrammetric Engineering and Remote Sensing, Journal of the American Society of Photogrammetry, Volume XLIV, No. 2, 1978.

COOKE, L. J. AND WARREN, W. W., A Recreation Study of the East Shore of Brule Lake, 1970.

CORBIN, R. B., A Potential Model for Land Use Allocation, Proposed Research on Land Use Analysis, Regional Development Branch, Ontario Department of Treasury and Economics, June, 1970.

COVENTRY CITY COUNCIL, A Strategy for Coventry - Solihull - Warwickshire, Coventry City Council, Solihull County, Borough & Warwickshire County Council, 1971.

COWLING, T. M. & STEELEY, G. C., Sub-Regional Planning Studies: An Evaluation, Urban & Regional Planning Series, Volume 6, Pergamon Press, Toronto, 1973.

CRANMER, V., Land Use Programs in Canada, Prince Edward Island, Lands Directorate, Environment Canada, 1974.

CRESSMAN, DAVID R., The Productive Capacity of the Natural Resource of Manitoulin Island, The Canada Land Inventory, 1968.

CRESSMAN, D. R. & HOFFMAN, D. W., Classifying Land for Recreation, Journal of Soil and Water Conservation,Volume 23, No. 3 May, June, 1968.

CRESSMAN, E. M., North Georgian Bay Recreational Reserve - A Land Use Approach, 1970.

CROWN, P. H., AND KOCAOGLU, S. S., Land Use Conflict in Alberta: Agriculture vs. Urban Developments, Agriculture Bulletin, University of Alberta, No. 25, Fall 1974.

CRUICKSHANK, J. G., "Why Land Classification?" *The Brunel Lecture*, The British Association for *the Advancement* of Science, Stirling Annual Meeting, Lecture September 6, 1974.

DAKIN, JOHN, "Resources for Tomorrow, The Background Papers - Resource Planning and Regional Planning", *Planning the Canadian Environment*, L. O. Gertler, editor, Harvest House Montreal, 1968.

DAVIDSON, A. T., Director of ARDA, *A Talk to the Senate Committee on Land Use*, February, 1962.

DEHEM, ROGER, *Concepts of Regional Planning*, Canadian Public Administration, 1966.

DESCHAMPS, R., *Conflicts in the Use of Forest Land in Quebec*, March, 1963.

DICKINSON, G., *A Technical Approach to Land Use Planning Based on the Canada Land Inventory*, British Columbia Department of Agriculture.

DICKINSON, G., AND KLOOSTERMAN, B., *Socio-Economic Factors in Land Classification*, Canadian Journal of Agricultural Economics, Volume 18, No. 2, 1970.

DIRSCHL, H. J. & MALIEPAARD, H.S., Canadian Wildlife Service and Saskatchewan Wildlife Branch, *Wildlife and Rural Development*, Report to the Co-ordinating Committee of the Torch River Rural Development Area, 1963.

DOOLING, P. J., *Perspectives on Alternative Approaches to and Evaluation Criteria of Recreation Resource Inventory and Assessment Systems for Provincial, Regional and Site Plans*, Proceedings, Wildland Recreation Conference, Banff, 1977.

DORNEY, R. S., *Ecological Land Use Planning in Canada: Issues, Methodology, Public, Professional and Business Interaction and Strategy for Implementation*, Canadian Council of Resource and Environment Ministers, Land Seminar, Fredericton, N. B., September, 1972

DOUGLAS, ROBERT W., *Forest Recreation*, Pergamon Press, Toronto, 1969.

DOYLE, F. J., The Next Decade of Satellite Remote Sensing, Photogrammetric Engineering and Remote Sensing, Journal of the American Society of Photogrammetry, Volume XLIV, No. 2, 1978.

DUFFY, P. J.B., The Use of Soil Survey Reports in the Appraisal of Forest Land Productivity in Alberta, Forestry Chronicle, June, 1962.

EDMONTON AND BATTLE RIVER REGIONAL PLANNING COMMISSIONS, The Pigeon Lake Study, 1975.

EDMONTON JOURNAL, Morinville, "Agriculturalists Concerned Over Speculators", Edmonton, October 22, 1975.

EDMONTON REGIONAL PLANNING COMMISSION, Country Residential Survey - Parkland County, Alberta Land Use Forum Technical Report 4A, 1974.

EDMONTON REGIONAL PLANNING COMMISSION, Lake and Lake Shoreland Capability Study, A Regional Perspective, September, 1974.

EDMONTON REGIONAL PLANNING COMMISSION, Parks, Outdoor Recreation and Open Space Policy, Position Paper No. 3, Regional Plan Project, 1976.

EDMONTON REGIONAL PLANNING COMMISSION, Regional Lake Perspective, 1974.

EDMONTON REGIONAL PLANNING COMMISSION, Rural Land Use Policy, Regional Plan Project, Position Paper No. 1, 1975.

EDWARDS, R. Y., The Future of Recreation on Wild Lands, Forestry Chronicle, Volume 44, 1968.

EKISTIC DESIGN CONSULTANTS LTD., A Preliminary Regional Plan for Northeast Alberta, 1976.

EVELYN, JOHN, Silva: Or a Discourse of Forest Trees, and the Propagation of Timber in His Majesty's Dominions, Volume II, London, 1776.

FORBES, J., A Map Analysis of Potentially Developable Land, University of Glasgow, Regional Studies, Volume 3, 1969.

FOUND, WILLIAM C., A Theoretical Approach to Rural Land Use Patterns, Toronto, MacMillan of Canada, 1971.

FOUND, W. C., & MCDONALD, G. T., The Canadian Geographer, The Spatial Structure of Agriculture in Canada - A Review, Volume XVI, No. 2, 1972.

FRIEDMANN, JOHN R. P., The Concept of a Planning Region, Land Economics, Volume 32, No. 1, 1956.

GEORGIAN BAY REGIONAL DEVELOPMENT COUNCIL, Land Use In Agriculture, Forestry & Outdoor Recreation - Economic Implications of Rural Land Use, 1971.

GERTLER, L. O., Editor, Planning the Canadian Environment, Harvest House, Montreal, 1968.

GLACKEN, C. J., "Origins of the Conservation Philosophy", Reading in Resource Management & Conservation, E. I. Burton and R. W. Kates, University of Chicago Press, 1965.

GRAHAM, G., Planning and Forest Management, Forestalk, Volume 1, No. 1, 1977.

GRANT, W. V., Discussion: A.R.D.A. and Poverty, Canadian Journal of Agricultural Economics, Volume 16, No. 3, 1968.

GREENBERG, M. R., & HORDON, R.M., Environmental Impact Statements: Some Annoying Questions, Journal of the American Institute of Planners, Volume 40, No. 3, May, 1974.

GRIGGS, R. M., Land Use Capabilities for Recreation at Hydro-Electric Reservoirs in British Columbia, prepared for B. C. Hydro and Power Authority, 1976.

GUELPH, UNIVERSITY OF, Centre for Resources Development, Planning for Agriculture in Southern Ontario, ARDA Report No. 7, 1972.

GUELPH, UNIVERSITY OF, Department of Land Resource Science, Use of Steroscopic Orthophotos for Soil Terrain-Analysis, L. S. Crosson & R. Protz, Proceedings on First Canadian Symposium on Remote Sensing, Volume 2, 1972.

GUELPH, UNIVERSITY OF, Environmental Change: Focus on Ontario, ed., D. E. Elrick, 1970.

HAMILL, L., Classification of Forest Land for Recreational Potential and Scenery, Forestry Chronicle, Volume 47, No. 3, 1971.

HARVARD UNIVERSITY, Landscape Architecture Research Office, Graduate School of Design, Three Approaches to Environmental Resource Analysis, published by The Conservation Foundation, Washington, D.C., 1967.

HEANEY, H. D., Conflicts in the Use of Forest Land in the Atlantic Provinces, Forestry Chronicle, March, 1963.

HILLS, G. A., LOVE, D.V., & LACATE, D. S., Developing a Better Environment: Ecological Land - Use Planning in Ontario, Toronto, Ontario Economic Council, 1970.

HILLS, G. A., The Ecological Basis for Land Use Planning, Ontario, Department of Lands and Forests, 1961.

HILLS, G. A., Research in Land Classification and Mapping for Multiple Resource Management, Annual Meeting of the Canadian Association of Geography, McMaster University, Hamilton, Ontario, 1962.

HOFFMAN, D. W., The Assessment of Soil Productivity for Agriculture, Department of Land Resource Science, University of Guelph, Guelph, Ontario, 1971.

HUTTON, C. L. A., Mapping Present Land Use in Alberta...an ARDA project, The Albertan Geographer, Department of Geography, University of Alberta, No. 2, 1965-66.

IRONSIDE, R. G., "Agricultural and Recreational Land Use in Canada: Potential for Conflict or Benefit?" Canadian Journal of Agricultural Economics, Volume 19, No. 2, 1971.

JEFFREY, W. W., BROWN, C. S., JURDANT, M., NOVAKOWSKI, N.S., & SPILSBURY, R. H., Foresters and the Challenge of Integrated Resource Management, Forestry Chronicle, Volume 46, 1970.

KENT, T., Land Use and Resource Planning, Forestry Chronicle, Volume 47, 1971.

KNEESE, ALAN & BOWER, BLAIR, ed., Environmental Quality Analysis, Theory and Method in the Social Sciences, Resources for the Future, 1972.

KOCAOGLU, S. S. & CROWN, P. H., Land Use Conflict in Alberta: Agriculture vs. Urban Developments, Agriculture Bulletin, University of Alberta, No. 25, Fall 1974.

KRISTJANSON, B. H., Resources for Tomorrow, Conference Background Papers, Volume 1, 1961.

KUMAR, PREM, Land Capability Assessment - Outdoor Recreation, Term Paper, Geography 566, University of Alberta, February, 1973.

LAYCOCK, A. H., Land and Water Resource Development in the Eastern Slopes, A brief submitted to the Environment Conservation Authority by the Alberta Geographical Society, July, 1973.

LAYCOCK, A. H., The Present Land Use Mapping Program, report to A.R.D.A. Inventory Study Group, Edmonton, 1967.

LIVINGSTON, JOHN A., One Cosmic Instant, A Natural History of Human Arrogance, McClelland & Stewart Ltd., Toronto, 1973.

LOOMIS, R. D., Conflicts in the Use of Land in Alberta, Forestry Chronicle, March, 1963.

LOWENTHAL, D., George Perkins Marsh and the American Geographical Tradition, Geographical Review, XCIII, No. 2, 1953.

LYLE, J. AND VON WODTKE, M., An Information System for Environmental Planning, American Institute of Planners, Journal, November, 1974.

MACLAREN LTD., JAMES, F., Environmental Consultants, Countryside Planning, A Pilot Study of Huron County, prepared for County of Huron and Ontario Ministry of Housing, 1976.

MADILL, R. J., Approaches to Multiple Use Planning, Forestry Chronicle, Volume 49, 1973.

MALTHUS, T. R., An Essay on the Principles of Population, 1890, in H. J. Barnett, "Malthusianism and Conservation", ed., I. Burton and R. W. Kates, Readings in Resource Management and Conservation, 1965.

MANITOBA, DEPARTMENT OF MINES & NATURAL RESOURCES, Canada Land Inventory Project, No. 12, Feasibility Study Resource Data Systems, 1970.

MANITOBA, DEPARTMENT OF MINES & NATURAL RESOURCES, Canada Land Inventory Project Report No. 4, Outdoor Recreation Capability Turtle Mountain Resource Conservation Council Inc. Project Area, Winnipeg, June 1968.

MANITOBA, DEPARTMENT OF MINES & NATURAL RESOURCES, Feasibility Study - Resource Data Systems, Progress Report - Canada Land Inventory Project, 1967.

MANITOBA, DEPARTMENT OF MINES & NATURAL RESOURCES, G. C. Jenkins, Land Use Study of the South Side Riding Mountain Area, A.R.D.A. Project 7038, 1970.

MANITOBA, DEPARTMENT OF MINES & NATURAL RESOURCES, A Proposed Storage and Retrieval System for Lake and Stream, Information in the Department of Mines & Natural Resources, February, 1971.

MANITOBA, DEPARTMENT OF MINES & NATURAL RESOURCES, Shellmouth Designated Reservoir Area Proposed Land Use Plan, Winnipeg, 1969.

MANITOBA, DEPARTMENT OF MUNICIPAL AFFAIRS, Municipal Planning - Rural Land Use Planning an Overview, An Occasional Newsletter, Issue No. 1, November, 1973.

MANITOBA, DEPARTMENT OF MUNICIPAL AFFAIRS, Municipal Planning - Rural Land Use Planning, Winnipeg Region Study, An Occasional Newsletter, Issue No. 2, May, 1974.

MANITOBA, DEPARTMENT OF MUNICIPAL AFFAIRS, Shoreland Recreation - An Environmental Approach to Development, 1971.

MANITOBA, UNIVERSITY, A Framework for Economic Planning of Watershed Drainage, Agassiz Centre for Water Studies, Research Report No. 6, 1972.

MANITOBA, UNIVERSITY, Regional Systems for Development in Manitoba, 1970.

MAROIS, B., Land Supply: The Availability of Land and the Provision of Space, Land Seminar, Canadian Council of Resource and Environment Ministers, Fredericton, N. B., September, 1972.

MARSH, G. P., Man and Nature, or, "Physical Geography As Modified by Human Action," ed., D. Lowenthal, Harvard University Press, 1965, originally published in 1864.

MCCLELLAN, J. B., The Land-Use Sector of the Canada Land Inventory, Geographical Bulletin, Volume 7, No. 2, 1965.

MCCLELLAN, J.B., RAYBURN, J. A.,&RAYMOND, C. W., Land Utilization in Prince Edward Island, Memoir 9, Geographical Branch, Department of Mines and Technical Surveys, Ottawa, 1963.

MCCRORIE, J. N., ARDA: An Experiment in Development Planning Special Study No. 2, prepared for the Canadian Council on Rural Development, Queen's Printer, Ottawa, 1969.

MCHARG, I. L., Design with Nature, published for the American Museum of Natural History, 1969.

MCHARG, I.L., Ecological Values and Regional Planning, Civil Engineering, A.S.C.E., August, 1970.

MCLAUGHLIN, J. B., Urban and Regional Planning, A Systems Approach, London, England, 1970.

MCMULLEN, D. N., AND BARNES, A.S.L., Watershed Management in Ontario Through Conservation Authorities, March, 1962.

NEW BRUNSWICK, ARDA Committee, Mactaquac Regional Development Plan - Summary Report, H. C. Acres & Company Ltd., 1965.

NIAGARA REGION STUDY REVIEW COMMISSION, Land Use Planning in the Niagara Region, 1976.

NICKOLSON, N. L., CORNWALL, I.H.B., & RAYMOND, C. W., Canadian Land Use Mapping, Geographical Branch, Ottawa, Geographical Paper No. 31, 1961.

NOBLE, H. F., An Economic Classification of Farms, Ontario Government, Department of Agriculture and Food, Toronto, 1965.

NORTHUMBERLAND AREA TASK FORCE, Final Report on the Preferred Development Strategy for the County of Northumberland, 1975.

NOVA SCOTIA, DEPARTMENT OF MUNICIPAL AFFAIRS, Background Study, Special Planning Area #1, Strait of Canso Region, Community Planning Division, 1973.

NOWICKI, J. J., Multiple Use and Management as it should be in Alberta, Paper, presented to National and Provincial Parks Association of Canada, Edmonton Chapter, October 22, 1972.

NOWICKI, J. J., Recreational Capability and Use of Some North Central Alberta Lakes, Geography Department, University of Alberta, 1969.

OLDMAN RIVER REGIONAL PLANNING COMMISSION, Castle River Valley Pilot Study, 1977.

OLDMAN RIVER REGIONAL PLANNING COMMISSION, Land Use and Resource Development in the Eastern Slopes - Oldman River Drainage Basin, report to Alberta Environment Conservation Authority, Information Bulletin No. 5, 1973.

OLDMAN RIVER REGIONAL PLANNING COMMISSION, Preliminary Regional Plan, 1974.

OLDMAN RIVER REGIONAL PLANNING COMMISSION, Regional Lakes Perspective, I; Inventory, 1975.

ONTARIO, DEPARTMENT OF AGRICULTURE & FOOD, Farm Economics, Co-operative & Statistics Branch, Variation in Farm Income of Farms in Eastern Ontario by Farm Types and Farm Class, An Economic Classification of Farms in Eastern Ontario, June, 1966.

ONTARIO, DEPARTMENT OF ECONOMICS & DEVELOPMENT, International Conference on Regional Development & Economics Change, 1965.

ONTARIO, DEPARTMENT OF ENERGY & RESOURCE MANAGEMENT, Conservation Report - Sault Ste. Marie Region, 1969.

ONTARIO, DEPARTMENT OF ENERGY & RESOURCE MANAGEMENT, Sydenham Valley Conservation Report, 1968.

ONTARIO, DEPARTMENT OF THE ENVIRONMENT, Niagara Peninsula Conservation Report Volume I, 1972.

ONTARIO, DEPARTMENT OF LANDS & FORESTS, The Ecological Basis for Land Use Planning, by G. A. Hills, Research Report No. 46, December, 1961.

ONTARIO, DEPARTMENT OF LANDS & FORESTS, Multiple Use of Forest and Lands, 1966.

ONTARIO, DEPARTMENT OF LANDS & FORESTS, The Glackmeyer Report of Multiple Land Use Planning, 1960.

ONTARIO, DEPARTMENT OF LANDS & FORESTS - Interdepartmental Committee on Conservation and Post-War Rehabilitation, The Ganaraska Watershed, 1944.

ONTARIO, DEPARTMENT OF MUNICIPAL AFFAIRS, Haldimand - Norfolk Study, A Regional Land Use Plan, 1970.

ONTARIO, DEPARTMENT OF MUNICIPAL AFFAIRS, Lakeshore Capacity - Inland Lakes of Ontario, Data Sources and Study Design, 1971.

ONTARIO, DEPARTMENT OF TREASURY AND ECONOMICS, Regional Development Branch, Design for Development Midwestern Ontario Region,Phase 1: Analysis, 1970.

ONTARIO, DEPARTMENT OF TREASURY AND ECONOMICS, Regional Development Branch, Design for Development: Niagara (South Ontario) Region, Phase 1: Analysis, June 2, 1970.

ONTARIO, DEPARTMENT OF TREASURY AND ECONOMICS, Regional Development Branch, Design for Development: Northeastern Ontario Region,Phase 1: Analysis, 1971.

ONTARIO, DEPARTMENT OF TREASURY AND ECONOMICS, Regional Development Branch, Design for Development Northwest Ontario Region, Phase 2: Policy Recommendation, October 13, 1970.

ONTARIO, DEPARTMENT OF TREASURY AND ECONOMICS, Regional Development Branch, Design for Development: The Toronto - Centred Region, May 5, 1970.

ONTARIO, DEPARTMENT OF TREASURY AND ECONOMICS, Regional Development Branch, The Land Capability Analysis Component of Ontario's Regional Development Plans, 1970.

ONTARIO, DEPARTMENT OF TREASURY AND ECONOMICS, Regional Development Branch, P. B. Corbin, A Potential Model for Land Use Allocation Proposed Research on Land Use Analysis, 1970.

ONTARIO, DEPARTMENT OF TREASURY AND ECONOMICS, Regional Development Branch, P. B. Corbin, The Relative Weighting of Land Use Capability Constraints, June 1970.

ONTARIO, ECONOMIC COUNCIL, Developing a Better Environment, Ecological Land Use Planning in Ontario, 1970.

ONTARIO, MINISTRY OF AGRICULTURE AND FOOD, Green Paper on Planning for Agriculture: Food Land Guidelines, 1977.

ONTARIO, MINISTRY OF HOUSING, Countryside Planning, A Pilot Study of Huron County, 1976.

ONTARIO, MINISTRY OF NATURAL RESOURCES, Interim Lake Planning Guidelines, May, 1977.

ONTARIO, MINISTRY OF NATURAL RESOURCES, Lake of the Woods General Land Use Plan, 1977.

ONTARIO, MINISTRY OF NATURAL RESOURCES, Hough, Stansbury & Associates Ltd., Toronto, Lake Alert Phrase 2, Methodology, 1972.

ONTARIO, MINISTRY OF TREASURY ECONOMICS & INTERGOVERNMENTAL AFFAIRS, The Haldimand - Norfolk Environmental Appraisal, Volume 1, Inventory & Analysis, 1972.

ONTARIO, MINISTRY OF TREASURY ECONOMICS & INTERGOVERNMENTAL AFFAIRS, The Haldimand - Norfolk Environmental Appraisal, Volume 2, Synthesis & Recommendations, 1972.

ONTARIO SELECT COMMITTEE ON CONSERVATION, Report to the Ontario Legislature, Toronto, 1950.

ONTARIO, TASK FORCE, Recreational Waters, Environmental Management of R. W. in Cottage Areas of Ontario, 1970.

PEACE RIVER - LIARD REGIONAL DISTRICT, The Finlay - Parsnip - Williston Lake Area, possibilities, factors, issues, concepts, October, 1972.

PEACE RIVER REGIONAL PLANNING COMMISSION, Land Use and Resource Development in the Eastern Slopes, Smoky River Drainage Basin, report to the Alberta Environment Conservation Authority, Information Bulletin No. 8, 1973.

PEACE RIVER REGIONAL PLANNING COMMISSION, correspondence from B. Buholzer to S. J. Collins, Provincial Planning, Municipal Affairs, May 21, 1974.

PEACE RIVER REGIONAL PLANNING COMMISSION, Patterns for the Future, A Regional Policy Plan for the Peace River Region of Alberta, 1976.

PEACE RIVER REGIONAL PLANNING COMMISSION, Sturgeon Lake Sub-regional Land Use Study, Area 1: Valleyview Corridor, 1972.

PEARSE, P. H., Principles of Allocating Wildland Among Alternative Uses, Canadian Journal of Agricultural Economics, Volume 17, No. 1, 1969.

PEARSON, N., "Planning for the Recreational Development of the Niagara Escarpment", *Regional and Resource Planning in Canada*, 1970.

PEARSON, N., KRUEGER, R. R., SARGENT, F. O., & DE VOS, A., ed., *Regional and Resource Planning in Canada*, Hold, Rinehart & Winston, Toronto, 1970.

PEARSON, N., *Time for a National Resources Plan*, Agricultural Institute Review, Volume 25, 1970.

PERLOFF, HARVEY S., *Key Features of Regional Planning*, Journal of the American Institute of Planners, 1968.

PETERS, T. W., *A Study of the relationship of yield data (wheat, oats and barley) to the agroclimates of Alberta, Soil zones of Alberta and the classes and sub-classes of soil capabilities for agriculture*, Alberta Institute of Pedology, 1972.

PETTAPIECE, W. W., *Land Classification and Soils in the Rocky Mountains of Alberta along the North Saskatchewan River Valley*, Alberta Institute of Pedology, 1971.

PEUCKER, THOMAS K., *Computer Cartography*, Commission on College Geography,Resources Paper No. 17, Association of American Geographers, Washington, D.C., 1972.

PHILBRICK, A. K., *The Erie Research Project: Its Relevance for Regional Development*, University of Western Ontario.

PHILIPS PLANNING & ENGINEERING LTD., *Regional Niagara Official Plan*, Working Draft, Regional Municipality of Niagara, 1972.

PLANNING & RESOURCES INSTITUTE, *The Concept of a Regional Development Plan, Progress Report: Regional Evaluation Phase*, Vol. 1, University of Waterloo, April, 1968.

PLANNING & RESOURCES INSTITUTE, *The Concept of a Regional Development Plan, Development Strategy and Implementation Phase Volume II*, University of Waterloo, February, 1970.

POETSCHKE, L. E., *A.R.D.A. and Poverty: Lessons in Development Planning*, Canadian Journal of Agricultural Economics, Volume 16, 1968.

POULIN, F., *The Planning of Regional Development Eastern Quebec*, Canadian Journal of Agriculture Economics, Volume 14, 1966.

PRINCE EDWARD ISLAND, DEPARTMENT OF DEVELOPMENT, *Land Valuation - Rural Property Classification and Grading*, 1970.

PROCTOR & REDFERN LTD., Paterson Planning & Research Ltd., *St. Johns Urban Region Study Regional Plan Report*, prepared for Department of Regional Economic Expansion - Newfoundland and Labrador, Department of Community and Social Development, January, 1973.

PROUDFOOT, B., & WILSON, J. T., *An Evaluation of Expanding Agriculture in the Saskatchewan River Delta of Northeastern Saskatchewan*, Proceedings: Symposium on the Lakes of Western Canada, Edmonton, 1973.

PROUDFOOT, B., & WILSON, J. T., *Land Capability, Farm Production and Profit*, British Association for the Advancement of Science, Stirling, 1974.

QUEBEC, OFFICE DE L'AGRICULTURE ET DE LA COLONISATION, Inventaire des Terres du Canada, *Les Systemes de Classement des Possibilites D'Utilisation des Sols*, 1969.

QUEBEC, OFFICE DE PLANIFICATION ET DUE DEVELOPPEMENT, *La Methodologie du Zonage des Terres: Salon Seurs Potentiels*, Inventaries Bio-Physiques du Quebec, 1971.

QUEBEC PLANNING BUREAU, *Analysis of Land Use Capability Ottawa River Region*, Quebec, Service of Bio-physical Studies and Inventories, 1972.

QUEBEC, PROVINCIAL CO-ORD. MEETING, *Geographic Information System*, 1969.

RASMUSSEN, L. W., *Allocating Resources in Accomplishing Research Objectives*, Agri. Sci. Rev. 2(1), 1964.

RAYBURN, J. A., RAYMOND, C. W.,&MCCLELLAN, J. B., *Land Utilization in Prince Edward Island*, Memoir 9, Geographical Branch, Department of Mines and Technical Surveys, Ottawa, 1963.

RAYMOND, C. W., MCCLELLAN, J. B.,&RAYBURN, J. A., *Land Utilization In Prince Edward Island*, Memoir 9, Geographical Branch, Department of Mines and Technical Surveys, Ottawa, 1963.

RED DEER REGIONAL PLANNING COMMISSION, *County of Paintearth, Multiple Land Use Problems*, Red Deer Regional Planning Commission, 1971.

RED DEER REGIONAL PLANNING COMMISSION, Land Use and Resource Development in the Eastern Slopes, North Saskatchewan and Red Deer River Basin, report to the Alberta Environment Conservation Authority, Information Bulletin No. 7, 1973.

RED DEER REGIONAL PLANNING COMMISSION, Physical Environment Inventory of the Red Deer Regional Planning Commission Area, 1972-73.

RED DEER REGIONAL PLANNING COMMISSION, Regional Lake Perspective, 1974.

RED DEER REGIONAL PLANNING COMMISSION, Regional Lake Perspective: Inventory and Policy Directions, 1976.

RED DEER REGIONAL PLANNING COMMISSION, Sylvan Lake Management Plan, A Summary Statement, 1977.

REEDS, L. G., The Land Use Survey of the Niagara Peninsula - A Critical Review, Geographical Bulletin, 7(324), 1965.

REES, W. E., The Canada Land Inventory in Perspective, University of British Columbia, 1977.

RICHARDS, J. H., Gross Aspects of Planning and Outdoor Recreation with Particular reference to Saskatchewan, The Canadian Geographer, Volume XI, 2, 1967.

RICHARDS, J. HOWARD, Perspective on Regional Planning, University of Saskatchewan, 1967.

RICHARDS, J. H., Recreation Potential of the Saskatchewan River Delta Area, Geography Department - University of Saskatchewan, Saskatoon, 1966.

RODD, S. R., Review of Canadian Policies for Rural Adjustment: A Study of the Economic Impact of A.R.D.A., PFRA and MMRA by H. Buckley and E. Tihanyi, Canadian Journal of Agricultural Economics, Volume 16, No. 3, 1968.

ROE, C. E., Innovative Techniques to Preserve Rural Land Resources, Environmental Affairs, Volume 5, No. 3, 1976.

ROWE, J. S., Environmental Impact of Forest Management Operations - Facts of Ecological Life, Forestry Chronicle, December, 1973.

ROWE, J. S., Soil, Site and Land Classification, Forestry Chronicle, Volume 38, 1962.

ROWE, J. S., Why Classify Forest Land?, Forestry Chronicle, Volume 47, 1971.

RUCKELSHAUS, W. D., New Questions on Land Use, Canadian Council of Resource and Environment Ministers, 1972.

RUSSELL, HONOURABLE D. J., Alberta, Minister of the Environment, Policy Statement: The Development of the Eastern Slopes, July 18, 1975.

SABINE, R. D., Pigeon Lake Summer Cottage Shoreland Use, M. Sc. Thesis, Geography Department, University of Alberta, 1969.

SARGENT, F. O., A Scenery Classification System, Journal of Soil and Water Conservation, Volume 21, No. 1, 1966.

SASKATCHEWAN, DEPARTMENT OF THE ENVIRONMENT, A Study of Land and Water Use at Emma and Christopher Lakes, 1976.

SASKATCHEWAN, UNIVERSITY OF, College of Agriculture, Soil Survey of Southern Saskatchewan from Township 1 to 48, Report No. 12, 1944.

SCHORTINGHUIS, S. W., Conflicts in the Use of Forest Land in Manitoba and Saskatchewan, Forestry Chronicle, March, 1963.

SCHULTZ, W. M., South Saskatchewan River Basin: Provisional Functional Region for Regional and Resource Planning, 1968.

SCOLLIE, F. B., Regional Planning in Ontario, Ontario Library Review, March, 1973.

SCOTT, A., An Economic Framework for Choosing Among Land Uses, Forestry Chronicle, March,1963.

SHOYAMA, T. K., Public Service and Regional Development in Canada, Journal of Economic History, 1966.

SINCLAIR, M. H., & BAIN, G. K., Provincial Land Use Mapping, Annual Meeting of the Canadian Association of Geographers, McMaster University, Hamilton, Ontario, 1962.

SMART, G. M., Reclamation of Forest Lands in Alberta, Coal Industry Reclamation Symposium, Banff, February, 1977.

SMITH, GUY HAROLD, ed., Conservation of Natural Resources, John Wiley & Sons Inc., New York, 1965.

SNEDDON, J. I., CUKOR, N., & FARSTAD, L., A Technique for Rapidly Determining Topograhic Class from Topographic Maps, Canadian Journal of Science, No. 52, October, 1972.

SPENCE-SALES, H. J., Proceedings of the Special Committee on Land Use in Canada, The Senate of Canada, Queen's Printer, 1957.

STURGEON MUNICIPAL DISTRICT, General Plan, 1972.

SWANNELL, L. F., Conflicts in the Use of Forest Lands in British Columbia, March, 1963.

SYMINGTON, D. F., Land Use in Canada, The Canada Land Inventory, Department of Forestry and Rural Development, Ottawa, reprinted from the Canadian Geographical Journal, February, 1968.

TAYLOR, GORDON D., THOMSON & CLARKE W., Proposed Methodology for an Inventory and Classification of Land for Recreational Use, Forestry Chronicle, June, 1966.

THOMAN, R. S., Design for Development in Ontario, The limitation of a Regional Planning Program, Ontario Department of Treasury and Economics, 1971.

THOMAN, R. S., Selected Bibliography on Regional Development in Canada and the United States, Toronto, 1971.

THORPE, F. J., "Historical Perspective on the Resources for Tomorrow Conference", Resources for Tomorrow, Conference Background Papers, Volume 1, 1961.

TIHANYI, E. & BUCKLEY, H., Canadian Policies for Rural Adjustment: A Study of the Economic Impacts of the ARDA, PFRA and MMRA Programs, Ottawa, Queen's Printer, 1967.

TOMLINSON, R. F., Editor, Environment Information Systems, Proceedings of the UNESCO/IGU Symposium on Geographical Information System, October, 1970.

TOMLINSON, R. F., An Introduction to the Geo-Information System of the Canada Land Inventory, A.R.D.A. - Canada Department of Forestry & Rural Development, 1967.

TOMLINSON, R. F., Provincial Co-ordinator's meeting, Quebec, Geographic Information System, Canada Land Inventory, February 13-15, 1969.

TOOGOOD, J. A., Our Soils are not Expendable, Edmonton Journal, Thursday, May 30, 1974.

TUNSTELL, G., "Using the Forest for Many Purposes", Resources for Tomorrow Conference Background Papers, Volume 2, 1961.

UNITED STATES, DEPARTMENT OF AGRICULTURE, The Why and How of Rural Zoning, Agriculture Information Bulletin No. 196, Economic Research Service, Department of Agriculture Washington, D.C., 1967.

UNITED STATES, DEPARTMENT OF THE INTERIOR, Outdoor Recreation Resources Review Commission, Multiple Use of Land and Water Areas, Volume 17, 1962.

UNITED STATES, DEPARTMENT OF THE INTERIOR, Outdoor Recreation Resources Review Commission, Outdoor Recreation for America, Washington, 1962.

WARD, E. L., Conflicts in the Use of Forest Lands in Ontario, The Forestry Chronicle, Volume 38, March, 1963.

WARKINTON, J., The Western Interior of Canada, The Carleton Library, No. 15, 1964.

WARREN, W. W., An Analysis of the Peers-Whitecourt Land Use Study, University of Alberta, Geography Department (term paper), 1970.

WARREN, W. W., Outdoor Recreational Geography, University of British Columbia, Geography Department (term paper), 1966.

WARREN, W. W., The Utilization of the Canada Land Inventory in Regional Planning, University of Alberta, Geography Department (term paper), 1970.

WARREN. W. W., & COOKE, L.J., A Recreation Study of the East Shore of Brule Lake, term paper, Geography Department, University of Alberta, 1970.

WATERLOO, REGIONAL MUNICIPALITY, Policy Paper No. 3, Economic Development, for discussion purposes leading to the Regional Official Policies Plan, Department of Planning and Development, 1974.

WEATHERHEAD, E., Geocoding - A Technique in the Development of Urban Information Systems, Ontario Economic Review, 8:5, 1970.

WILSON, J. T., Peers-Whitecourt Land Use Study - A Critique, 1972.

WILSON, J. T., An Economic Evaluation of Extending Agriculture in Northeastern Saskatchewan, Thesis, Geography Department, University of Alberta, 1973.

WILSON, J. T., & PROUDFOOT, B., An Evaluation of Expanding Agriculture in the Saskatchewan River Delta of Northeastern Saskatchewan , Proceedings: Symposium on the Lakes of Western Canada, Edmonton, 1973.

WILSON, J. T., & PROUDFOOT, B., Land Capability, Farm Production and Profit, British Association for the Advancement of Science, Stirling, 1974.

WILSON, K., Peers-Whitecourt Land Use Study - A Critique, 1972.

WINGER, R., An Analysis of Methods for Determining the Development Capacity of Recreational Lakes, University of Waterloo, 1974.

WOOD, HAROLD A., Small Scale Land Use Mapping - A Critique, Annual Meeting of the Canadian Association of Geographers, McMaster University, Hamilton, Ontario, 1962.

YANNACONE JR., V. J., Future Land Use - Energy, Environmental and Legal Constraints, R. W. Burchell, D. Listokin, Centre for Urban Policy Research, Rutgers - The State University, New Brunswick, New Jersey, 1975.

YOUNG, A., Against Land Classification, Proceedings of the International Geographical Union, Montreal, 1972.

APPENDIX A

SUMMARY OF
CLASSIFICATION FOR PRESENT LAND USE

Category		Symbol
I	URBAN	
	Land used for urban and associated non-agricultural purposes.	
	1. Built-up Area (Parks and other open spaces within built-up areas are included).	B
	2. Mines, Quarries, Sand and Gravel Pits (Land used for the removal of earth materials).	E
	3. Outdoor Recreation (Golf courses, parks, beaches, summer cottage areas, game preserves and historical sites).	O
II	AGRICULTURAL LANDS	
	1. Horticulture, Poultry and Fur Operations Land used for intensive cultivation of vegetables and small fruits including market gardens, nurseries, flower and bulb farms, and sod farms. Large scale commercial fur and poultry farms are also included because of their specialized agricultural nature.	H

Category		Symbol
II	2. Orchards and Vineyards - Land used for the production of tree fruits, hops and grapes.	G
	3. Cropland - Land used for annual field crops: grain oilseeds, sugar beets, tobacco, potatoes, field vegetables, associated fallow, and land being cleared for field crops.	A
	4. Improved Pasture and Forage Crops - Land used for improved pasture or for the production of hay and other cultivated fodder crops including land being cleared for these purposes.	F
	5. Rough Grazing and Rangeland a) Areas of natural grasslands, sedges, herbaceous plants and abandoned farmland whether used for grazing or not. Bushes and trees may cover up to 25 percent of the area. If in use, intermittently-wet hay lands (sloughs or meadows) are included.	K

Category		Symbol
II	b) Woodland grazing: If the area is actively grazed and no other use dominates, in some grassy, open woodlands, bushes and trees may somewhat exceed 25 percent cover.	
III	WOODLAND Land covered with tree, scrub or bush growth, including:	
	1. Productive Woodland - Wooded land with trees having over 25 percent canopy cover and over approximately 20 feet in height. Plantations and artificially reforested areas are included regardless of age.	T
	2. Non-Productive Woodland - Land with trees or bushes exceeding 25 percent Crown cover, and shorter than approximately 20 feet in height. Much cut-over and burned-over land is included.	U
IV	WETLAND	
	Swamp, Marsh or Bog - Open wetlands, except those which frequently dry up, and show evidence of grazing or hay cutting. (see K Agricultural Lands).	M

Category		Symbol
V	UNPRODUCTIVE LAND Land which does not, and will not, support vegetation. e.g., eroded soil or rock and active depositional features.	
	1. Sand (Sand bars, sand flats, dunes, beaches)	S
	2. Rock and Other Unvegetated Surfaces - (Rock barrens, badlands, alkali flats, gravel bars, eroded river banks, mine dumps).	L
VI	WATER	Z

Source: Canada, Department of Regional Economic Expansion, The Canada Land Inventory, *Objectives Scope and Organization*, Report No. 1., 1970.

APPENDIX B

SUMMARY OF

SOIL CAPABILITY CLASSIFICATION FOR AGRICULTURE

In this classification, on the basis of soil survey information, mineral soils are grouped into seven classes. Soils in Classes 1, 2, 3 and 4 are considered capable of sustained use for cultivated field crops; those in Classes 5 and 6 only for perennial forage crops, and those in Class 7 for neither.

Important criteria on which the classification system is based are:

- soils will be well managed and cropped, using a largely mechanized system;
- land requiring improvements (including clearing) that can be made economically by the owner is classed according to its limitations or hazards in use as if the improvements have been made. Land requiring improvements deemed beyond the means of the individual owner is classed according to its present condition.
- these factors are not considered: distances to market, type of roads, location, size of farms, type of ownership, cultural patterns, skill or resources of individual operators, and hazard of crop damage by storms.

The classification does not include capability of soils for trees, tree fruits, small fruits, ornamental plants, recreation, or wildlife.

The classes are based on intensity rather than the type of agricultural limitations they display. Each class includes many kinds of soils, and many of the soils in a class need different management and treatment.

CLASSES

1 - SOILS IN THIS CLASS HAVE NO SIGNIFICANT LIMITATIONS IN USE FOR CROPS

The soils are deep, are well to imperfectly drained, hold moisture well, and in the virgin state were well supplied with plant nutrients. They can be managed and cropped without difficulty. Under good management they are moderately high to high in productivity for a wide range of field crops.

2 - SOILS IN THIS CLASS HAVE MODERATE LIMITATIONS THAT RESTRICT THE RANGE OF CROPS OR REQUIRE MODERATE CONSERVATION PRACTICES

The soils are deep and hold moisture well. The limitations are moderate and the soils can be managed and cropped with little difficulty. Under good management they are moderately high to high in productivity for a fairly wide range of crops.

3 - SOILS IN THIS CLASS HAVE MODERATELY SEVERE LIMITATIONS THAT RESTRICT THE RANGE OF CROPS OR REQUIRE SPECIAL CONSERVATION PRACTICES

The limitations are more severe than for Class 2 soils. They affect one or more of the following practices: timing and ease of tillage; planting and harvesting; choice of crops; and methods of conservation. Under good management they are fair to moderately high in productivity for a fair range of crops.

4 - SOILS IN THIS CLASS HAVE SEVERE LIMITATIONS THAT RESTRICT THE RANGE OF CROPS OR REQUIRE SPECIAL CONSERVATION PRACTICES, OR BOTH

The limitations seriously affect one or more of the following practices: timing and ease of tillage; planting and harvesting; choice of crops; and methods of conservation. The soils are low to fair in productivity for a fair range of crops but may have high productivity for a specially adapted crop.

5 - SOILS IN THIS CLASS HAVE VERY SEVERE LIMITATIONS THAT RESTRICT THEIR CAPABILITY TO PRODUCING PERENNIAL FORAGE CROPS, AND IMPROVEMENT PRACTICES ARE FEASIBLE

The limitations are so severe that the soils are not capable of use for sustained production of annual field crops. The soils are capable of producing native or tame species of perennial forage plants, and may be improved by use of farm machinery. The improvement practices may include clearing of bush, cultivation, seeding, fertilizing, or water control.

6 - SOILS IN THIS CLASS ARE CAPABLE ONLY OF PRODUCING PERENNIAL FORAGE CROPS AND IMPROVEMENT PRACTICES ARE NOT FEASIBLE

The soils provide some sustained grazing for farm animals, but the limitations are so severe that improvement by use of farm machinery is impractical. The terrain may be unsuitable for use of farm machinery, or the soils may not respond to improvement, or the grazing season may be very short.

7 - SOILS IN THIS CLASS HAVE NO CAPABILITY FOR ARABLE CULTURE OR PERMANENT PASTURE

This class also includes rockland, other non-soil areas, and bodies of water too small to show on the maps.

O - ORGANIC SOILS (Not placed in capability classes)

SUBCLASSES

Excepting Class 1, the classes are divided into subclasses on the basis of kinds of limitation. The subclasses are:

C - adverse climate - The main limitation is low temperature or low or poor distribution of rainfall during the cropping season, or a combination of these limitations.

D - undesirable soil structure and/or low permeability - The soils are difficult to till, absorb water slowly or the depth of the rooting zone is restricted.

E - erosion damage - Past damage from erosion limits agricultural use of the land.

F - fertility - Low natural fertility due to lack of available nutrients, high acidity or alkalinity, low exchange capacity, high levels of calcium carbonate or presence of toxic compounds.

I - inundation - Flooding by streams or lakes limits agricultural use.

M - moisture - A low moisture holding capacity, caused by adverse inherent soil characteristics, limits crop growth (not to be confused with climatic drought).

N - salinity - The soils are adversely affected by soluble salts.

P - stoniness - Stones interfere with tillage, planting and harvesting.

R - shallowness to solid bedrock - Solid bedrock is less than three feet from the surface.

S - soil limitations - A combination of two or more subclasses D, F, M and N.

T - adverse topography - Either steepness or the pattern of slopes limits agricultural use.

W - excess water - Excess water, other than from flooding, limits use for agriculture. The excess water may be due to poor drainage, a high water table, seepage or runoff from surrounding areas.

X - minor cumulative limitations - Soils having a moderate limitation due to the cumulative effect of two or more adverse characteristics which individually would not affect the class rating. (This subclass is always used alone and only one level below the best possible class in a climatic sub-region).

Source: Canada, Department of Regional Economic Expansion, The Canada Land Inventory, Objectives, Scope and Organization, Report No. 1, 1970.

SUMMARY OF
THE CLIMATES OF CANADA FOR AGRICULTURE

The productivity of land depends on climate as well as soil Climate dictates what crops may be grown and is mainly responsible for yearly variation in yields. A classification of land in the broad sense of the term must take climate into account. To a considerable extent soil profiles reflect the effects of climate, and soil zones serve in a general way as climatic zones. However, a description of climate is needed for an understanding of the environment.

Temperature Zones

These temperature zones are based on degree days (d.d.) above 42°F and the frost-free (f.f.) period. The agricultural areas of Canada have been divided into temperature zones as follows:

1. Above 4,000 d.d.
2. 3,500 to 4,000 d.d.
3. 3,000 to 3,500 d.d.
4. 2,600 to 3,000 d.d.
5. 2,200 to 2,600 d.d. and 90+ f.f. days in Alberta and Saskatchewan
6. 1,800 to 2,200 d.d. and 75 to 90 f.f. days in Alberta and Saskatchewan

7. Less than 1,800 d.d. and less than 75 f.f. days in Alberta and Saskatchewan

All seven zones occur in British Columbia and Ontario, zones 3 to 7 on the Prairies and Quebec, 4 to 7 in the Maritimes and 6 and 7 in Newfoundland.

Moisture Classes

These moisture classes are based on average water deficiency and average May to September precipitation. The agricultural areas of Canada have been divided into moisture classes as follows:

Class	Water deficiency (inches)	May - Sept. precipitation (inches) Over 2600 d.d.*	Under 2600 d.d.*
C	over 12	Under 6	-
D	12 - 9	6 - 8	-
E	9 - 7	8 - 11	8 - 9
F	7 - 5	10 - 12	9 - 11
G	5 - 3	12 - 13	10 - 13
H	3 - 1	13 - 15	12 - 15
K	1 - 0	15 - 16	14 - 18
L	0	-	16 - 20
M	0	-	over 20

*d.d. = Degree days above 42°F

All nine classes occur in British Columbia, Classes D to L on the Prairies, only the four from G to L in Ontario, three (H,K,L) in Quebec, three (K,L,M) in the Maritimes and two (L, M) in Newfoundland.

By combining seven temperature zones with nine moisture classes, sixty-three climatic regions are possible. The various temperature and moisture combinations mapped are listed below.

1. C, G,
2. C, F, G, H
3. C, D, E, F, G, H, K, L, M
4. C, D, E, F, G, H, K, L, M
5. E, F, G, H, K, L, M
6. E, F, G, H, K, L, M
7. G, H

Source: Canada, Department of Forestry and Rural Development. The Canada Land Inventory, The Climates of Canada for Agriculture, Report No. 3, 1966.

APPENDIX D

SUMMARY OF

LAND CAPABILITY CLASSIFICATION FOR FORESTRY

In this classification all mineral and organic soils are grouped into one of seven classes based upon their inherent ability to grow commercial timber. The best lands of Canada for commercial tree growth will be found in Class 1; those in Class 7 cannot be expected to yield timber in commercial quantities; these classes represent the extremes. Because of unsuitable climate no Class 1 lands will be found in several regions of Canada, and in certain regions the Class 2 areas will be too small to show at the chosen scales of mapping.

Important factors on which classification is based are:

- All known or inferred information about the unit including subsoil, soil profile, depth, moisture, fertility, landform, climate and vegetation.
- A productivity range associated with each capability class based on the mean annual increment of the best species, or group of species, adapted to the site at, or near, rotation age. Productivity classes are expressed in gross merchantible

cubic foot volume to a minimum diameter of four inches. Thinnings, bark, and branch wood are not included. The productivity as expressed is that of "normal", i.e., fully stocked stands. It may be assumed that only good management would have produced stands of this nature.

- The following factors are not considered: location, access, distance to markets, size of units, ownership, present state or special crops such as Christmas trees.

The classes are based on the natural state of the land without improvements such as fertilization, drainage or amelioration practices. It is realized that in some instances productivity may change with improved forest management to the degree that limitations shown in the symbol may alter and/or class changes may take place. However, significant changes will only be achieved through costly and continuing practices.

CLASSES

1 - LANDS HAVING NO IMPORTANT LIMITATIONS TO THE GROWTH OF COMMERCIAL FORESTS

Soils are deep, permeable, of medium texture, moderately well-drained to imperfectly drained. They have good water-holding capacity and are naturally high in fertility. Their topographic position is such that they frequently receive seepage and nutrients from adjacent areas. They are not subject to extremes of temperature or evapotranspiration. Productivity will usually be greater than 111 cubic feet per acre per year.

When required this class may be subdivided on the basis of productivity into Classes 1 (111 to 130), 1a (131 to 150), 1b (151 to 170), 1c (171 to 190), 1d (191 to 210), and by 20 cubic foot classes thereafter, as necessary.

2 - LANDS HAVING SLIGHT LIMITATIONS TO THE GROWTH OF COMMERCIAL FORESTS

Soils are deep, well-drained to moderately well-drained, of medium to fine texture and have good water-holding capacity.

The most common limitations (all of a relatively slight nature) are: adverse climate, soil moisture deficiency, restricted rooting depth, somewhat low fertility, and the cumulative effects of several minor adverse soil characteristics. Productivity will usually be from 90 to 110 cubic feet per acre per year.

3 - LANDS HAVING MODERATE LIMITATIONS TO THE GROWTH OF COMMERCIAL FORESTS

Soils may be deep to somewhat shallow, well to imperfectly drained, of medium to fine texture with moderate to good water-holding capacity. They may be slightly low in fertility or suffer from periodic moisture imbalances.

The most common limitations are: adverse climate, restricted rooting depth, moderate deficiency or excess of soil moisture, somewhat low fertility, impeded soil drainage, exposure (in maritime areas) and occasional inundation.

Productivity will usually be from 71 to 90 cubic feet per acre per year.

4 - LANDS HAVING MODERATELY SEVERE LIMITATIONS TO THE GROWTH OF COMMERCIAL FORESTS

Soils may vary from deep to moderately shallow, from excessive through imperfect to poor drainage, from coarse to fine texture, from good to poor moisture holding capacity, from good to poor structure and from good to low natural fertility.

The most common limitations are: moisture deficiency or excess, adverse climate, restricted rooting depth, poor structure, excessive carbonates, exposure, or low fertility.
Productivity will usually be from 51 to 70 cubic feet per acre per year.

5 - LANDS HAVING SEVERE LIMITATIONS TO THE GROWTH OF COMMERCIAL FORESTS

Soils are frequently shallow to bedrock, stoney, excessively or poorly drained, of coarse or fine texture. They may have poor moisture holding capacity and be low in natural fertility.
The most common limitations (often in combination) are: moisture deficiency or excess, shallowness to bedrock, adverse regional or local climate, low natural fertility, exposure particularly in maritime areas, excessive stoniness and high levels of carbonates.
Productivity will usually be from 31 to 50 cubic feet per acre per year.

6 - LANDS HAVING SEVERE LIMITATIONS TO THE GROWTH OF COMMERCIAL FORESTS

The mineral soils are frequently shallow, stoney, excessively drained, of coarse texture and low in fertility. A large percentage of the land in this class is composed of poorly drained organic soils.

The most common limitations (frequently in combination) are: shallowness to bedrock, deficiency or excess of soil moisture, high levels of soluble salts, low natural fertility, exposure, inundation and stoniness.

Productivity will usually be from 11 to 30 cubic feet per acre per year.

7 - LANDS HAVING SEVERE LIMITATIONS WHICH PRECLUDE THE GROWTH OF COMMERCIAL FORESTS

Mineral soils are usually extremely shallow to bedrock, subject to regular flooding, or contain toxic levels of soluble salts. Actively eroding or extremely dry soils may also be placed in this class. A large percentage of the land is very poorly drained organic soils.

The most common limitations are: shallowness to bedrock, excessive soil moisture, frequent inundation, active erosion, toxic levels of soluble salts and extremes of climate or exposure.

Productivity will usually be less than 10 cubic feet per acre per year.

SUBCLASSES

Except for Class 1, subclasses indicate the kind of limitation for each class. The subclasses are as follows:

Climate - Denotes a significant adverse departure from what is considered the median climate of the region, that is, a limitation as a result of local climate. Adverse regional climate is expressed by the class level.

A - droughty or arid conditions as a result of climate;

C - a combination of more than one climatic factor, or when it is not possible to decide which of two or more features of climate is significant;

H - low temperatures, that is too cold;

U - exposure.

Soil Moisture - Denotes a soil moisture condition less than optimum for the growth of commercial forests, but not including inundation.

M - soil moisture deficiency;

W - soil moisture excess;

X - a pattern of "M" and "W" too intimately associated to map separately.

Permeability and Depth of Rooting Zone - Denotes limitations of soil permeability of physical limitation to rooting depth.

D - physical restriction to rooting by dense or consolidated layers, other than bedrock;

R - restriction of rooting zone by bedrock;

Y - intimate pattern of shallowness and compaction or other restricting layers.

Other Soil Factors - Denote factors of the soil which, individually or in combination, adversely affect growth.

E - actively eroding soils;

F - low fertility;

I - soils periodically inundated by streams or lakes;

L - excessive levels of calcium;

N - excessive levels of toxic elements, such as soluble salts;

P - stoniness which affects forest density or growth;

S - a combination of soil factors, none of which by themselves would affect the class level but cumulatively lower the capability class.

TREE SPECIES INDICATORS

The species which can be expected to yield the volume associated with each class are shown as part of the symbol. Only indigenous species adapted to the region and land are shown. Where only one species indicator is shown in a complex, it applies to all classes.

Examples of species symbols are:

pP	Ponderosa Pine
alF	Alpine Fir
lP	Lodgepole Pine
D	Douglas Fir
eS	Engelmann Spruce

Source: Canada, Department of Regional Economic Expansion, The Canada Land Inventory, *Objectives, Scope and Organization*, Report No. 1, 1970.

SUMMARY OF
LAND CAPABILITY CLASSIFICATION FOR RECREATION

Seven classes of land are differentiated on the basis of the intensity of outdoor recreational use, or the quantity of outdoor recreation which may be generated and sustained per unit area of land per annum under perfect market conditions.

"Quantity" may be measured by visitor days, a visitor day being any reasonable portion of a 24 hour period during which an individual person uses a unit of land for recreation.

"Perfect market conditions" implies uniform demand and accessibility for all areas, which means that location relative to population centres and to present access do not affect the classification.

"Intensive and dispersed activities" are recognized. "Intensive activities" are those in which relatively large numbers of people may be accommodated per unit area, while "dispersed activities" are those which normally require a relatively larger area per person.

Important factors affecting the classification are:

- The purpose of the inventory is to provide a reliable assessment of the quality, quantity and distribution of the natural recreation resources within settled parts of Canada.

- The inventory is essentially of a reconnaissance nature, based on interpretation of aerial photographs, field checks, and available records. The finished maps should be interpreted accordingly.
- The inventory classification is designed in accordance with present popular preferences in non-urban outdoor recreation. Urban areas (generally over 1,000 population with permanent urban character), as well as some non-urban industrial areas, are not classified.
- Land is ranked according to natural capability under existing conditions, whether in natural or modified state. But no assumptions are made concerning its capability of if is given further major artificial modifications.
- Sound recreation land management and development practices are assumed for all areas in practical relation to the natural capability of each area.
- Water bodies are not directly classified. Their recreational values accrue to the adjoining shoreland or land unit.
- Opportunities for recreation afforded by the presence in an area of wildlife and sports fish are indicated in instances where reliable information was available. But the ranking does not reflect the biological productivity of the area; wildlife capability is indicated in a companion series of maps.

CLASSES

1 - LANDS IN THIS CLASS HAVE VERY HIGH CAPABILITY FOR OUTDOOR RECREATION

Class 1 lands have natural capability to engender and sustain very high annual use based on one or more recreational activities of an intensive nature.

Class 1 land units should be able to generate and sustain a level of use comparable to that evident at an outstanding and large bathing beach or a nationally known ski slope.

2 - LANDS IN THIS CLASS HAVE A HIGH CAPABILITY FOR OUTDOOR RECREATION

Class 2 lands have natural capability to engender and sustain high annual use based on one or more recreational activities of an intensive nature.

3 - LANDS IN THIS CLASS HAVE A MODERATELY HIGH CAPABILITY FOR OUTDOOR RECREATION

Class 3 lands have natural capability to engender and sustain moderately high annual use based usually on intensive or moderately intensive activities.

4 - LANDS IN THIS CLASS HAVE MODERATE CAPABILITY FOR OUTDOOR RECREATION

Class 4 lands have natural capability to engender and sustain moderate annual use based usually on dispersed activities.

5 - LANDS IN THIS CLASS HAVE MODERATELY LOW CAPABILITY FOR OUTDOOR RECREATION

Class 5 lands have natural capability to engender and sustain a moderately low total annual use based on dispersed activities.

6 - LANDS IN THIS CLASS HAVE LOW CAPABILITY FOR OUTDOOR RECREATION

Class 6 lands lack the natural quality and significant features to rate higher, but have the natural capability to engender and sustain low annual use based on dispersed activities.

7 - LANDS IN THIS CLASS HAVE VERY LOW CAPABILITY FOR OUTDOOR RECREATION

Class 7 lands have practically no capability for any popular types of recreation activity, but there may be some capability for very specialized activities with recreation aspects, or they may simply provide open space.

SUBCLASSES

Subclasses indicate the kinds of features which provide opportunity for recreation. They are, therefore, positive aspects of land and do not indicate limitations to use. Features may be omitted from a unit, either because of the imposed three-feature limit, or because their presence was unknown or unconfirmed.
The degree to which these features are judged capable, collectively, of generating and sustaining use for recreation determines the class.

The sequence in which they are listed indicates the order of their significance. Subordinate features may be relatively insignificant and the class of a unit should not be interpreted to indicate the capability of a second or third use.

The subclasses are:

A - land providing access to water affording opportunity for angling or viewing of sports fish;

B - shoreland capable of supporting family beach activities. In high class units this includes family bathing. In Classes 4 and 5, the activities may preclude bathing due to water temperature or other limitations;

C - land fronting on and providing direct access to waterways with significant capability for canoe tripping;

D - shoreland with deeper inshore water suitable for swimming, or boat mooring, or launching;

E - land with vegetation possessing recreational value;

F - waterfall or rapids;

G - significant glacier view or similar experience;

H - historic or pre-historic site;

J - area offering particular opportunities for gathering and collecting items of popular interest;

K - shoreland or upland suited to organized camping. This subclass is usually associated with other features;

L - interesting landform features other than rock formations;

M - frequent small water bodies, or continuous streams occuring in upland areas;

N - land (usually shoreland) suited to family or other recreation lodging use;

O - land which affords an opportunity for viewing of upland wildlife;

P - areas exhibiting cultural landscape patterns of agricultural, industrial or social interest;

Q - areas exhibiting variety, in topography or land and water relationships, which enhances opportunities for general outdoor recreation such as hiking and nature study or for aesthetic appreciation for the area;

R - interesting rock formations;

S - a combination of slopes, snow conditions and climate providing downhill skiing opportunities;

T - thermal springs;

U - shoreland fronting water accommodating yachting or deep water boat tripping;

V - a vantage point or area which offers a superior view relative to the class of the unit(s) which contain it, or a corridor or other area which provides frequent viewing opportunities;

W - land affording opportunity for viewing of wetland wildlife;

X - miscellaneous features with recreational capability;

Y - shoreland providing access to water suitable for popular forms of family boating;

Z - areas exhibiting major, permanent, non-urban man-made structures of recreational interest.

Source: Canada, Department of Regional Economic Expansion, The Canada Land Inventory, Objectives, Scope and Organization, Report No. 1, 1970.

SUMMARY OF
LAND CAPABILITY CLASSIFICATION FOR UNGULATES

In general, the needs of all ungulates are similar; the individual of each species requires sufficient amounts of the proper food, protective cover, and space to survive, grow, and reproduce. The land's ability to meet these needs is determined by the individual requirements of the species, or group, under consideration, the physical characteristics of the land, and factors, such as climatic, which influence plant and animal life.

The land is divided into units on the basis of physiographic characteristics important to wild ungulates. The degree of limitation associated with each unit determines its capability class. The subclass denotes the primary factor that causes the limitation.

This classification system is based on two important considerations:

- Capability ratings are established on the basis of the optimum vegetational stage (successional stage) that can be maintained with good wildlife management practices.
- Capability ratings assigned do not reflect present land use (except in extreme cases such as heavily populated urban areas), ownership, lack of access, distance from cities, or amount of

hunting pressure.

CLASSES

1 - LANDS IN THIS CLASS HAVE NO SIGNIFICANT LIMITATIONS TO THE PRODUCTION OF UNGULATES

Capability on these lands is high. They provide a wide variety and abundance of food, plants and other habitat elements.

1W - Lands in this special class are Class 1 winter ranges on which animals from surrounding areas depend.

2 - LANDS IN THIS CLASS HAVE VERY SLIGHT LIMITATIONS TO THE PRODUCTION OF UNGULATES

Capability on these lands is high, but less than Class 1. Slight limitations are due to climatic, or other factors.

2W - Lands in this special class are Class 2 winter ranges on which animals from surrounding areas depend.

3 - LANDS IN THIS CLASS HAVE SLIGHT LIMITATIONS TO THE PRODUCTION OF UNGULATES

Capability on these lands is moderately high, but productivity may be reduced in some years. Slight limitations are due to characteristics of the land that affect the quality and quantity of habitat, or to climatic factors limiting the mobility of ungulates, or the availability of food and cover.

3W - Lands in this special class are Class 3 winter ranges on which animals from surrounding areas depend.

4 - LANDS IN THIS CLASS HAVE MODERATE LIMITATIONS TO THE PRODUCTION OF UNGULATES

Capability on these lands is moderate. Limitations are similar to those in Class 3, but the degree is greater.

5 - LANDS IN THIS CLASS HAVE MODERATELY SEVERE LIMITATIONS TO THE PRODUCTION OF UNGULATES

Capability on these lands is moderately low. Limitations are usually a combination of two or more factors of climate, soil moisture, fertility, depth to bedrock or other impervious layer, topography, flooding, exposure, and adverse soil characteristics.

6 - LANDS IN THIS CLASS HAVE SEVERE LIMITATIONS TO THE PRODUCTION OF UNGULATES

Capability on these lands is very low. Limitations are so severe that they are easily recognized; for example, soil depth may be negligible or climatic factors so extreme that ungulate populations are severely reduced.

7 - LANDS IN THIS CLASS HAVE LIMITATIONS SO SEVERE THAT THERE IS NO UNGULATE PRODUCTION

SUBCLASSES

With the exception of Class 1, the classes are divided into subclasses according to the nature of the limitations, which determine the class. In most cases, the limitations do not affect the animals themselves, but rather the ability of the land to produce suitable food and cover plants. For convenience the subclasses are placed in two main groups: those relating to climate and those relating to inherent characteristics of the land.

Climate

The following subclasses are used to denote significant climatic factors that may affect either the animals or the ability of the land to produce suitable food and cover:

A - aridity - Drought or aridity that adversely affects the habitat;

C - climate - A combination of climatic factors acting to reduce favourable habitat, and the production and survival of ungulates;

Q - snow depth - Excessive snow depth that reduces the mobility of ungulates and availability of food plants;

U - exposure or aspect - Special climatic factors, such as exposure to prevailing winter winds, that adversely affect the animals or their habitat.

Land

The following subclasses are used to denote significant characteristics of land that limit its usefulness for producing suitable food and cover. Some may also have a slight adverse effect on the animals:

F - fertility - Lack of nutrients in the soil for optimum plant growth;

G - landform - Poor distribution or interspersion of landforms necessary for optimum ungulate habitat;

I - inundation - Excessive water level fluctuation or tidal action that adversely affects the habitat or survival of ungulates;

M - soil moisture - Poor soil moisture, either excessive or deficient;

N - adverse soil characteristics - Excessive salinity, lack of essential trace elements, or abundance of toxic elements in the soil;

R - soil depth - Restriction of the rooting zone by bedrock or other impervious layers;

T - adverse topography - Either steepness or flatness of the land.

UNGULATE INDICATOR SPECIES

Species of ungulates for which capability ratings are assigned are shown by the following symbols.:

A	Antelope
C	Caribou
D	Deer (white-tailed deer, Columbia black-tailed deer, mule deer)
E	Elk
G	Mountain Goat
M	Moose
S	Mountain Sheep

Source: Canada, Department of Regional Economic Expansion, The Canada Land Inventory, Objectives, Scope and Organization, Report No. 1, 1970.

APPENDIX G

SUMMARY OF
LAND CAPABILITY CLASSIFICATION FOR WATERFOWL

In general, the needs of all waterfowl are similar; the individual of each species requires sufficient amounts of the proper food, protective cover, and space to survive, grow, and reproduce. The land's ability to meet these needs is determined by the individual requirements of the species, or group under consideration, the physical characteristics of the land, and other factors that influence the plant and animal communities.

The land is divided into units on the basis of physiographic characteristics important to waterfowl populations. The degree of limitation associated with each unit determines its capability class. The subclass denotes the primary factor that causes the limitation.

This classification system is based on two important considerations:

- Capability ratings are established on the basis of the optimum vegetational stage (successional stage) that can be maintained when good wildlife management is practiced.

- Capability ratings assigned do not reflect present land use (except in extreme cases such as heavily populated urban areas), ownership, lack of access, distance from cities, or amount of hunting pressure.

CLASSES

1 - LANDS IN THIS CLASS HAVE NO SIGNIFICANT LIMITATIONS TO THE PRODUCTION OF WATERFOWL

Capability on these lands is very high. They provide a wide variety and abundance of important habitat elements. Rolling topography is well-suited to the formation of wetlands. Predominant water areas on these lands include shallow and deep permanent marshes, and deep, open water areas with well-developed marsh edges.

1S - Water areas in this special class are Class 1 areas also serving as important migration stops.

2 - LANDS IN THIS CLASS HAVE VERY SLIGHT LIMITATIONS TO THE PRODUCTION OF WATERFOWL

Capability on these lands is high but less than Class 1. Slight limitations are due to climate, fertility, or soil permeability. Topography tends to be more undulating than rolling; a higher proportion of the water areas than in Class 1 are small temporary ponds or deep, open water areas with poorly developed marsh edges.

2S - Water areas in this special class are Class 2 areas also serving as important migration stops.

3 - LANDS IN THIS CLASS HAVE SLIGHT LIMITATIONS TO THE PRODUCTION OF WATERFOWL

Capability on these lands is moderately high, but productivity may be reduced in some years because of occasional droughts. Slight limitations are due to climate or to characteristics of the land that affect the quality and quantity of habitat. These lands have a high proportion of both temporary and semi-permanent shallow marshes poorly interspersed with deep marshes and bodies of open water.

3S - Water areas in this special class are Class 3 areas also serving as important migration stops.

3M - Lands in this special class may not be useful for waterfowl production, but are important as migration or wintering areas. This class has no subclasses.

4 - LANDS IN THIS CLASS HAVE MODERATE LIMITATIONS TO THE PRODUCTION OF WATERFOWL

Capability on these lands is moderate. Limitations are similar to those in Class 3, but the degree is greater. Water areas are mainly temporary ponds, or deep, open waters with poorly developed marsh edges, or both.

5 - LANDS IN THIS CLASS HAVE MODERATELY SEVERE LIMITATIONS TO THE PRODUCTION OF WATERFOWL

Capability on these lands is moderately low. Limitations are usually a combination of two or more of the following factors:

climate, soil moisture, permeability, fertility, topography, salinity, flooding, and poor interspersion of water areas.

6 - LANDS IN THIS CLASS HAVE SEVERE LIMITATIONS TO THE PRODUCTION OF WATERFOWL

Capability on these lands is very low. Limitations are easily identified. They may include aridity, salinity, very flat topography, steep-sided lakes, extremely porous soils, and soils containing few available minerals.

7 - LANDS IN THIS CLASS HAVE SUCH SEVERE LIMITATIONS THAT ALMOST NO WATERFOWL ARE PRODUCED

Capability on these lands is negligible or non-existent. Limitations are so severe that waterfowl production is nearly or completely precluded.

SUBCLASSES

With the exception of Class 1, and special Class 3M, classes are divided into subclasses according to the nature of the limitations that determine the class. The following subclasses are used to denote significant limiting factors that may affect either the waterfowl or the ability of the land to produce suitable habitat conditions.

A - aridity - The limitation is an arid contition of the land, or the susceptibility of the land to periodic droughts resulting in low pond water levels or premature drying of marshes during the breeding season.

B - free-flowing water - The limitation is usually due to fast or excess water flow, which inhibits development of marsh habitat along stream edges. It may also be due to a lack of flow through low-lying land, which results in poor quality habitat.

C - climate - A combination of adverse climatic factors may act to reduce favourable habitat, and thus the production and survival of waterfowl.

F - fertility - The limitation indicates insufficient nutrients in the soil and water for optimum plant growth.

G - landform - Poor distribution or interspersion of marshes or basins may be a limiting factor of the land and may prevent the development of an optimum waterfowl habitat.

I - inundation - The limiting factor is excessive water level fluctuation, or tidal action, adversely affecting the habitat or the nesting success of waterfowl.

J - reduced marsh edge - The limitations are topographic features adversely affecting development of optimum marsh conditions along the edge of water areas.

M - soil moisture - Poor water holding capacity of soils, adversely affecting the formation and permanency of water areas.

N - adverse soil and water characteristics - Excessive salinity, alkalinity, acidity, lack of essential trace elements, or abundance of toxic elements may limit the development of plant and animal communities essential for waterfowl production.

R - soil depth - Restriction of the rooting zone by bedrock or other impervious layers may limit development of suitable plant communities.

T - adverse topography - Steepness or flatness of the land may limit the development or permanency of wetlands.

Z - water depth - Excessively deep or shallow waters may limit the development of optimum waterfowl habitat.

Source: Canada, Department of Regional Economic Expansion, The Canada Land Inventory, Objectives, Scope and Organization, Report No. 1, 1970.

APPENDIX H

SUMMARY OF

CAPABILITY CLASSIFICATION OF FRESH WATERS FOR SPORT FISH

Because sport fish are carnivores at the peak of the food chain, their yield capability is low in terms of energy in the system. Capability of individual water bodies for sport fish depends on both the habitat of the food chain organisms, and of the sport fish themselves.

Sport fish capability of individual water areas with equal inputs of solar energy is classified on the basis of nutrients. The class is determined by the degree to which physical and chemical factors limit the habitat of the food chain organisms and the sport fish. Subclasses are the factors which cause the limitation.

Research data, recorded observations and experience are used as the basis for placing water areas in capability classes and subclasses. Where such information is lacking, classes and subclasses are assigned on the basis of experience gained with similar water areas elsewhere.

Good sport fish management practices, which are feasible and practical, are assumed. Present production is useful for classification only when it reflects capability of sport fish production.

Present use (including pollution), ownership, access, angling pressure or distance from roads or cities offer no limitation to the capability of the water for sport fish.

Capability ratings are subject to change as new information becomes available.

CLASSES

1 - WATERS IN THIS CLASS HAVE NO IMPORTANT LIMITATIONS TO THE PRODUCTION OF SPORT FISH

Class 1 waters are fertile, fairly shallow, or have ample shoal areas. They are warm, well oxygenated and free of inorganic turbidity.

2 - WATERS IN THIS CLASS HAVE SLIGHT LIMITATIONS TO THE PRODUCTION OF SPORT FISH

Class 2 waters have a good level of nutrients but may have slight limitations due to physical and/or chemical factors.

3 - WATERS IN THIS CLASS HAVE MODERATE LIMITATIONS TO THE PRODUCTION OF SPORT FISH

Class 3 waters are relatively poor in nutrients, with moderate to severe limitations to game fish production.

4 - WATERS IN THIS CLASS HAVE SEVERE LIMITATIONS TO THE PRODUCTION OF SPORT FISH

Class 4 waters are poor in nutrients, and have severe limitations to game fish production.

SUBCLASSES

D - depth - Limitations due to depth could include mean depth, littoral development, or basin shape.

F - flow - Limitations include irregular water flow in streams, water level fluctuations or changes in flushing rate.

L - light penetration - Limitation due to inorganic turbidity.

N - nutrient - Limitation due to lack of nutrient in the water.

O - oxygen - Limitation due to shortage of dissolved oxygen at all seasons of year. Extreme cases of oxygen deficiency show up through a winter or summer kill of fish populations.

T - temperature - Limitation may be due to low surface temperature, or to unfavourable thermal stratification.

S - special factors - Moderate limitations due to a single factor, or the cumulative effect of two or more adverse characteristics, which may affect class ratings. The factors may include short shoreline compared to area, ion imbalance, or lack of special physical features such as spawning facilities.

Source: Canada, Department of Regional Economic Expansion, The Canada Land Inventory, Objectives, Scope and Organization, Report No. 1, 1970.

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Government of Canada
Department of Mines and Technical Surveys
Geographical Branch
Present Land Use Sector - Canada Land Inventory
Summer 1964

Government of Saskatchewan
Department of Natural Resources
Resource Lands Branch
Recreation Sector - Canada Land Inventory
Summers 1965 - 1967

Government of Alberta
Department of Municipal Affairs
Provincial Planning Branch
Research Planning Section
Planning Officer
1967 - 1968

Head Research Planning Section
1969 - 1974

Manager Regional Planning Section
1975 - 1977

Government of Alberta
Department of Business Development and Tourism
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